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Electrical Auxiliaries on Ships.

APART from using electricity for the propulsion of ships, the problem of its use for driving the various auxiliaries is one which has engaged the attention of electrical engineers for a considerable time past. The amount of power required to operate all the auxiliaries on a ship depends to a large extent upon the nature of the service for which the vessel is designed, but in a merchant ship of the intermediate type carrying both passengers and cargo it can be assumed that the auxiliary power is of the order of about 15 per cent. of the power of the main propelling machinery. Thus on a vessel like the *Viceroy of India*, of 17,000 s.h.p., the auxiliary load would be of the order of 2,000 h.p., representing some 1,500 kW. Actually the auxiliary equipment of the vessel is in excess of this capacity. In these days when economy of operation is of the utmost importance, it is apparent that the auxiliary power must be generated and utilised with the highest efficiency, and it is because of this fact that the electric motor is to be preferred to the small reciprocating steam engine which hitherto has been so extensively employed for driving the auxiliary machinery on board ship, both in the engine room and on deck. Apart from its own inherent inefficiency, the small reciprocator suffers from the great disadvantage that its use involves the installation of bulky and unsightly steam feed and exhaust pipe lines between the boilers to the engine, and they constitute a source of additional loss due to the condensation which must inevitably occur in them, no matter how well they may be lagged with heat-insulating material. The electric motor, on the other hand, obtains its power from a large generator driven by an engine operating under conditions of maximum efficiency, the cables being of small dimensions and capable of being run between the generator switchboard and the motor control panel in unobtrusive casings, the transmission losses being small.

While, however, the electric motor is being very extensively employed on board ship for driving all kinds of auxiliary machinery, it suffers from certain well-defined disadvantages, particularly in cases when the load on the motor is of a rapidly and violently fluctuating nature. When the load is of a steady character, such as when driving a centrifugal

pump, or a fan, the ordinary constant-voltage type of motor can be, and is being, used with complete reliability, the control gear comprising a simple starting resistance with the necessary no-load and overload cut-outs; but for the steering gear and to a far greater extent for the capstans, the windlasses, and the cargo winches, in which cases the load varies between wide limits, the constant-voltage system has left much to be desired. In particular, for the cargo winches, the control of which may be in the hands of inexpert stevedores who have only been used to handling steam-driven winches, the risk due to sudden overloading of the motors and so on may be very great. We have seen electrically-driven cargo winches of which the control levers and brakes were designed in exact replica of those of a steam winch in an attempt to obtain more careful handling of the motors, but this arrangement, as well as the contactor arrangement which has been adopted by many makers in conjunction with the constant-voltage system of supply, leaves much to be desired when placed in the hands of men inexperienced in handling electrically-driven machinery.

It is in order to overcome these disadvantages that the Austin constant-current system has been developed: in contradistinction to the system hitherto employed, the voltage of the circuit is varied according to the demand for power, the current being maintained at a constant value. This system has been adopted for the various auxiliaries on the new P. & O. liner *Viceroy of India*, as described elsewhere in this issue, and it may be emphasised that the Austin system is of particular value when used in conjunction with motors subjected to considerable variation of load, such as the capstan and winch motors, since it eliminates troubles due to circuit breakers and even when the motor is stalled by overload, as when a cargo lift is run to the top of the derrick, there is no danger to the motor, the power being actually reduced owing to the counter voltage of the exciter. Again, motors operated on the constant-current system can hold their load stationary without the use of a brake, while the energy derived from descending loads, as in the case of cargo winches, can be returned to the line, the motors being regenerative. It is to be noted that the Austin constant-current system is applicable to all types of ship in which there is a considerable auxiliary load, and while it happens that the *Viceroy of India* is electrically propelled, its use is, of course, entirely independent of the system of propulsion employed. On any ship where it is planned to use electricity for driving the auxiliary machinery (the electricity being obtained from the usual auxiliary generators), the Austin constant-current system can be adopted with but little modification of the generating plant, and thus the advantages of the electric drive outlined above can be obtained without the usual disadvantages. We learn that the auxiliary machinery on the *Viceroy of India* has so far proved extremely satisfactory up to the time of the vessel sailing on her maiden voyage on March 28th. We hope that authoritative information will be forthcoming in the near future regarding its behaviour under the more onerous conditions of commercial service at sea and in foreign ports in the hands of inexperienced men.

Extensions or Bulk Supplies?

Attention is once again drawn to the necessity for guarding against any tendency to impede the progress of electricity supply in this country during the transition stages of the Government schemes. Revelations made at a recent meeting of the Epsom Urban District Council suggest that the electricity undertaking is "hard hit," and that there is undue delay in obtaining sanction for new plant, or in securing an alternative supply in bulk. It appears that the present plant in the station, 11,350 kW, has been fully taxed this winter, and at times overloaded. Apparently a Fullagar oil-engne set is being installed at present but it has been realised that it will not be nearly sufficient to meet the load of the 1929-30 winter. Some idea of the growth of the load at Epsom can be gathered from the fact that for four weeks prior to March the energy generated by the undertaking amounted to 332,701 kWh, and that in the corresponding period of last year 230,034 kWh was generated.

In November last application was made to the Electricity Commissioners for sanction to the installation of a second set, but at the time of the meeting referred to sanction had not been received. The gravity of the situation is evidenced by a statement to the effect that if the second set, or an alternative supply, is not available by next winter the Electricity Committee will have to cease to develop the demand for electricity, or to discourage, or stop, the hire of domestic electrical apparatus, and to confine new consumers to lighting only.

Any such suggestion in these days is decidedly "unhealthy," and the fact that it emanates from an undertaking that has increased its output by something approaching 50 per cent. in a year indicates that the responsibility for the position may not rest locally.

It appears also that the undertaking has had an offer of a bulk supply from the London and Home Counties Joint Electricity Authority, but that it does not consider that such a supply can be available in time for the load of next winter. Lack of development, or enterprise, in any one undertaking does not affect that concern only; it reflects on the whole supply industry.

The problem of bulk supply versus local generating plant extension must be solved by the machinery set up under recent legislation, but the vital point is that the curtailment of supply under any conditions should not be allowed. The authorities should see to it that either sanction for extension is given promptly when necessary to progress, or that where the introduction of an outside supply is the "economic procedure," pressure is brought to bear on an undertaking which is reluctant to accept a bulk supply.

French Technical Industries.

From information to hand from a correspondent in France, it appears that there is some perturbation in French commercial circles in regard to the situation of the French electrical and other technical industries. *La Métallurgie* emphasizes the necessity of developing foreign markets, for notwithstanding that French industries enjoy at present a very strong position in their own markets, defence must be organised against two powerful rivals, the United States and Germany. In the United States, industries continue to flourish, and although their own demands absorb practically the whole of their output, since their exports amount to only 10 per cent. of their production, these exports must necessarily develop under American methods of super-production, which tend to reduce costs. These methods are difficult to implant in France. However, if American competition presents a danger for to-morrow, that from Germany is more imminent, for Germany, it is stated, intends to resume the privileged situation which she enjoyed before the war, and even to recapture her former position in the French markets. It is considered that, in order to meet these powerful rivals, France must adopt methods to standardise her manufactures, to encourage the supply of skilled workmen by modifying conditions of apprenticeship, to augment the output of the workmen now available by means of wage bonuses, and to organise factories and plant in such a way as to increase production and reduce costs by every means possible. These remedies are of course to be directed towards ordinary commercial competition, but the payments being made by Germany under the Dawes plan in machinery and electrical apparatus is a form of competition which is the result of questions of national politics, and demands special attention. French industrial leaders assert that they have no wish to kill this mode of payment, particularly in view of their position as taxpayers; but they naturally protest vehemently when they find their own markets flooded with products similar to their own, but of German origin. These are

the words of Monsieur Dalbouze, president of the Syndicat des Industries Mécaniques Françaises:—"To-morrow the South American, embarking for Europe by a French line of steamers, will travel on a boat built in Germany; disembarking at Bordeaux he will see the port worked with German plant; he will telephone to Paris with German apparatus, and by wire made in Germany; he will enter a German railway coach on a railroad electrified by Germany; if he visits a French workshop the machine tools will be German, driven by electric motors made in Germany; while in a French institute the microscopes will be of German construction." In the opinion of the journal these manufactured goods received from Germany should be sold by France to Anglo-Saxon countries, and a strong propaganda movement should be made in favour of French manufactures. Of course, it is more than probable that electrical people in the aforesaid Anglo-Saxon countries may have other views regarding the flooding of their markets with these German reparations goods. They expressed themselves in no uncertain terms several years ago respecting electrical reparations in kind direct from Germany.

Two Important Committees.

We reported in our last issue that the Electricity Commissioners had appointed two committees, representative of the electrical interests concerned, to consider and report on (*a*) facilities for the hire or hire-purchase by consumers of installations and appliances, with special reference to rural areas; and (*b*) the question of greater uniformity in charges and tariffs for electricity. Both matters are of the greatest importance to the electrical industry, and the constitution of the committees is such that practical proposals, aiding electrical development, are assured.

In urban areas the provision of hire and hire-purchase facilities has already made good progress, but a great deal remains to be done. The rural areas are only now being considered, and it is in this direction that the ingenuity of the committee will be taxed. Rural electrification is very largely dependent upon some satisfactory arrangement for the easy-purchase of installations and appliances by consumers, and the committee is asked to "make proposals for a practical financial scheme for this purpose." The venture will call for a certain amount of courage, but we feel sure that it will form a safe and remunerative long-term investment for suppliers of energy, installations and apparatus, all of whom are represented on the committee.

The task of the second committee is an unenviable one. The electrical industry is badly handicapped by lack of standardisation in all directions, but in no department is there so much variety as in tariffs and charges. Of course, local conditions determine the level of *prices*, but this can hardly be said of the *methods* of charging. The "two-part" system has given excellent opportunities for originality. The ratable value of the premises appears to be the most popular basis of calculation, and it is probably the best in the long run; but other methods are employed, such as a fixed charge per lamp, per room, per sq. ft. of floor space, or on the wattage installed, with many variations. Some undertakings appear to make a purely arbitrary fixed charge while some go to inordinate trouble to ensure that all factors are taken into account. We may appropriately conclude with the following quotation from the recently-published statement of charges in its District by the London & Home Counties Joint Electricity Authority; it applies to one of the companies:—

"Domestic Tariff Telephone System.—A fixed annual charge to be assessed by the Company, plus 2d. per unit up to 20 units per quarter per £1 of annual fixed charge and 1½d. per unit thereafter. The fixed charge is calculated as follows:—1s. 3d. per annum per £1 of ratable value, plus 4s. per annum for each 100 sq. ft. floor area of living rooms, kitchen and bedrooms, plus 1s. 6d. per annum per 20-watt lamp installed except occasional lamps (in passages, cellars, sculleries, bathrooms, &c.) up to one quarter of total connections, less 20 per cent."

This is perhaps the worst of many "horrible examples" with which the Committee will be faced, and shows the need for offering the consumer simpler terms.

Latest Improvements.

There is no doubt that the number of houses being built by private enterprise has greatly increased—at any rate in the London area—and certainly the competition existing among builders to-day is unprecedented. Houses are being sold by the aid of modern selling schemes, advertising campaigns, and so on, and almost without exception the outstanding "pull" used by the builder is "latest improvements."

It is without doubt that electricity offers more in the way of "latest improvements" than any other public service, but the builders cannot be said to take much advantage of that fact. Occasionally one sees "house wired throughout for power," but "gas points in all rooms" is too frequently met with. The problem involves the old question of supply charges, it is true, and in many places the supply undertaking must largely share the responsibility for the lack of provision for full domestic electrical development. But where domestic electricity tariffs are sufficiently low to permit claims of competition with the gas supply for heating and cooking, the builder's apparent preference for gas often prevails.

The solution then lies in "educating the builder." In this connection the Electrical Association for Women is doing excellent work by means of its outlet campaign; but that is not sufficient. To bring the builder into line with modern development the combined forces of all bodies concerned with the advancement of electrical service is required; then with the support of the heavy artillery of the supply undertakings in the form of low domestic charges, the result will be a battle won.

X-Rays in the Foundry.

The X-ray examination of materials has been advocated during the last ten years at least, but although it has been urged on many occasions by authorities that it could be advantageously used for the examination of castings before any machining operations were performed on them, the foundry industry has hitherto never been more than mildly interested in the subject. At the recent conference on steel castings in Glasgow there was considerable discussion about the relative value of X-ray examination, and it was stated by one speaker that "the next best thing is to cut up a casting before proceeding with the bulk." Whilst the cutting up of one casting is effective for repetition work, a large proportion of the total steel castings made are of the one-off kind, and X-rays ought to be more used than they are for the inspection of comparatively thin castings, the class of castings indeed that are most difficult to produce free from defects. That the application of X-rays has limitations of a serious kind must be admitted: they will not penetrate very thick metal, and small defects cannot always be detected by their aid; again, stresses may exist that are not indicated, yet it is significant that a foundry journal should urge that facilities for X-ray examination should be placed at the disposal of individual foundries, either by the Government Departments that purchase steel castings, or by a co-operative organisation supported by the foundry industry. X-rays, or no X-rays, the production of sound steel castings is exceedingly difficult and complex problems in connection with melting practice are involved. At the Glasgow conference already mentioned, an instance was cited of a steel foundry that uses an electric furnace and is turning out perfect castings, and there can be no doubt that were electric furnaces more generally used, the proportion of waster castings would be considerably reduced.

The Austin Constant-current System.

A brief description of its nature and merits in marine applications, and an outline of an installation aboard a large all-electric passenger liner recently built in this country.

By D. SMEATON MUNRO, M.I.E.E.,

THE separately generated constant-current system as practically applied to drive capstans, winches, forced-draught fans, pumps, and other auxiliary gear on board the new P. & O. liner *Viceroy of India** is of great electrical and shipping interest. This system, which has been already referred to in outline, is a modern development of the Thury high-voltage d.c. arrangement which was designed for long-distance power transmission. To-day long-distance transmission is effected on the a.c. constant-e.h.p. system, and the constant-current method is unsuitable for general town distribution, but it has most attractive characteristics for driving certain classes of machinery within a limited area, such as the confines of a ship. The dynamo generates d.c. of constant value, which circulates in a closed series circuit through the motors, while the voltage varies according to the demand for power. When a motor controller is in the "off" position the motor is short circuited, so that the current is by-passed quite free of the motor windings by means of a simple cam-operated switch. The generators, motors, switchgear, and cables, are all of the design which Gilbert Austin, Ltd., have perfected within recent years. The system gets rid of all the troubles attendant on the use of circuit breakers and fuses for protecting deck motors against overload, as the current limit in the circuits cannot be increased.

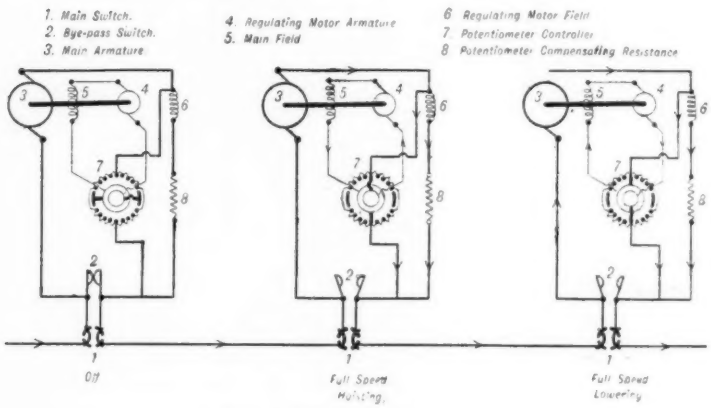


Fig. 1.—Motor Connections.

A constant-current motor, if its normal load is increased, will carry the overload for which it is designed, and if the overload is still further increased the armature will slow down, and even stop, but at the same time it holds on to its load and so prevents harm. A feature of the constant-current motor is that when actually stalled by overload, although the torque is increased, the demand for power is reduced to approximately 1/20 full-load current, which apparent paradox is caused by the stalled motor ceasing to produce a counter voltage and the exciter (which is a feature of the generator) accordingly reduces the voltage of generator. The series circuit has a further safeguard in that the generator itself cannot be overloaded. It can only maintain the full line current from zero up to the voltage for which it is designed; if pressed beyond that limit there is an automatic reduction of current. The main object of the application of the constant-current method to marine work, however, is to provide electric motors that are effective over the utmost speed range and under all loads, having the good qualities of a steam engine, which, when pulled up by overload, consumes little or no steam in the process.

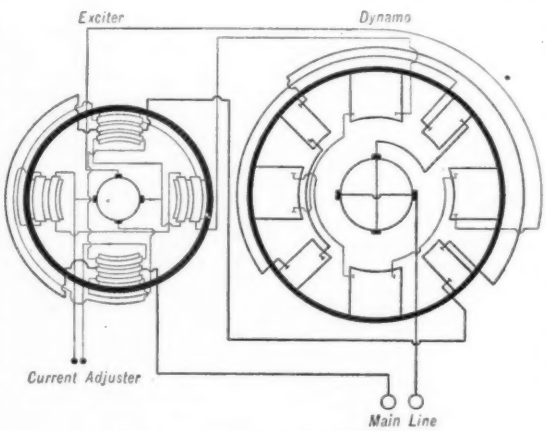


Fig. 2.—Generator Connections.

In practice, the constant-current motors run throughout the unusual full-load speed range of zero to maximum, and may be switched from full speed forward to full reverse with ease and without risk of damage. In

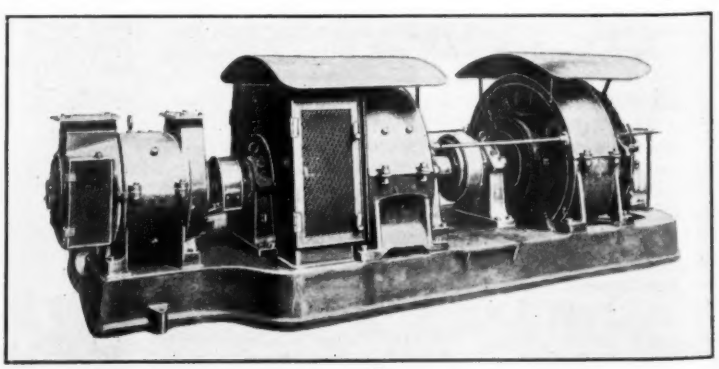


Fig. 3.—Motor-generator and Exciter, 150 kW, 220 V.

* Elec. Rev., March 8th, 1929, p. 414.

the case of capstans, or winches, the motors will hold their loads stationary without the use of brakes and

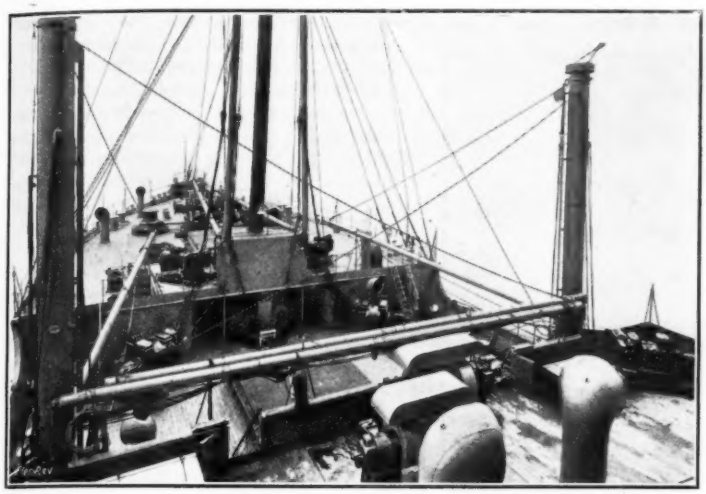


Fig. 4.—View of Windlass, Capstans and Winches.

with only a very small demand on the dynamo. When driving a plunger pump, for which purpose other types of electric motor have notably failed, the discharge valves may be closed without damage to the pump, or to the running constant-current motor. Energy from the descending loads on winches, &c., helps to raise other loads, as the motors are regenerative, so the generator output need be very much less than the total capacity of all the series motors in full operation.

The Generator.—The interpoled machine is constructed on lines which are practically standard and a separate low-voltage exciter is fitted on a shaft extension. The exciter raises, or lowers, the voltage of the generator according to the varying demands for energy required by the motors, so that the average current is maintained in the system while the pressure varies with the load on the circuits.

Reference to fig. 2 will show that the exciter has two sets of windings and two sets of brushes: initial excitation is obtained from the primary brushes under adjustable control by a field rheostat, while the current for the main excitation of the dynamo is derived from the other sets of windings and brushes. The dynamo main-line current passes through coils on the exciter poles and has a balancing influence on the primary excitation. An additional set of windings is provided to impart compounding effects and to balance armature reactions. The machine is started on short circuit, *i.e.*, under no-load conditions, and the rheostat is adjusted until a balance is obtained at the correct line current. On the one hand, should the main current tend to decrease the primary excitation will predominate and quickly restore the balance by increasing the main-field excitation. On the other hand, should the main current increase the exciter action will be reversed and tend to reduce the main-field excitation until the balance is again restored. The action of the exciter is very rapid, and in practice the current remains as steady as the voltage generally does in an ordinary d.c. constant-voltage machine of comparable output.

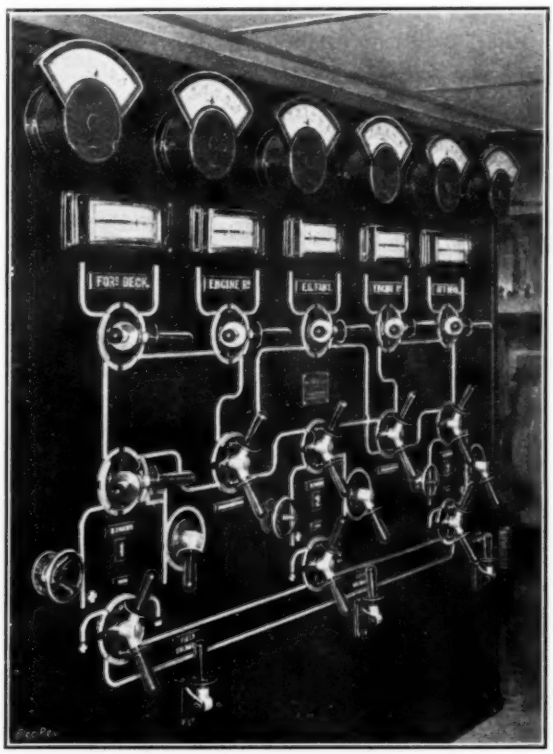


Fig. 5.—Austin Main Control Board.

The Line.—Energy distribution on the Austin system is extremely simple and inexpensive, compared with the usual elaborate networks installed for ships' motors and their controlling gear. All that is required is a lead and return, which take the form of a single-core cable passing from the generator round to all the motors in series and back to the generator. A special type of cable known as "Osmotite" has been designed for marine work by Messrs. Gilbert Austin, Ltd., and is claimed to be proof against osmotic and electrolytic actions. The primary insulation is lead sheathed and a layer of special insulating compound that is impervious to moisture and salt spray and is further protective by tape is interposed between the lead and the outer armour of steel, braid, and compound. The interposed secondary insulation is also of great value in testing.

The Motors.—The machines used consist of a main and a regulating motor mounted on one shaft. When the by-pass switch is opened the line current flows through the main armature and then on to excite the regulating motor field. At each controller a small resistance is inserted in the main line to divert the exciting current through the main-motor field, which is in series with the armature of the regulating motor. Fig. 1 shows the motor connec-

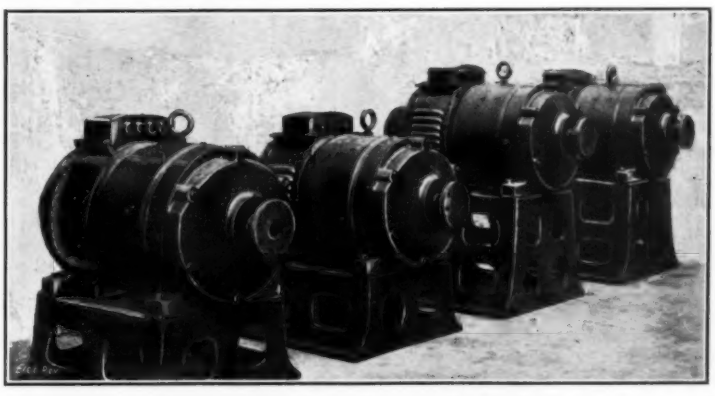


Fig. 6.—Forced-draught Fan Motors.

tions with a reversing type of controller. As soon as the switch is opened the entering current gives rise to a small voltage difference at the terminals of the controller resistance; that voltage is used to shunt some

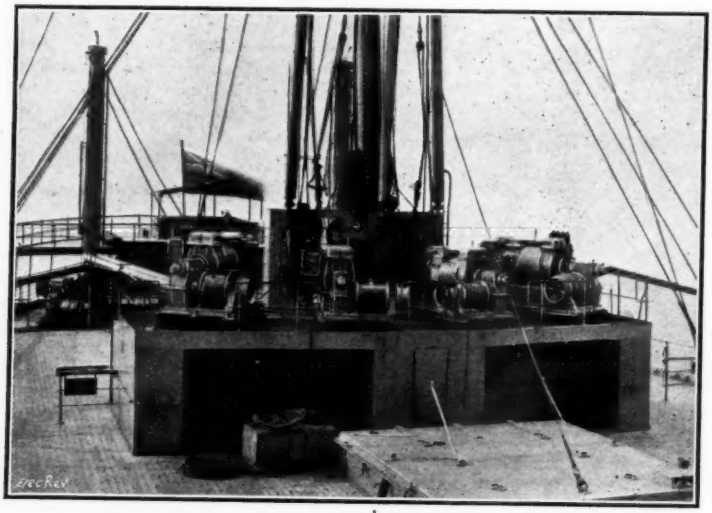


Fig. 7.—Group of Winches on Raised Aft Deck.

of the main-line current through the field circuit, and so the field current can be adjusted to any required value. That the speed may be controlled under varying loads, the small armature is connected to oppose the voltage of the controller resistance. At no load the speed rises until the voltage of the small armature is almost equal to that of the controller, and the torque is at a minimum. At full load again the speed falls and the small armature voltage is reduced sufficiently to permit the full-load exciting current to flow through the field windings.

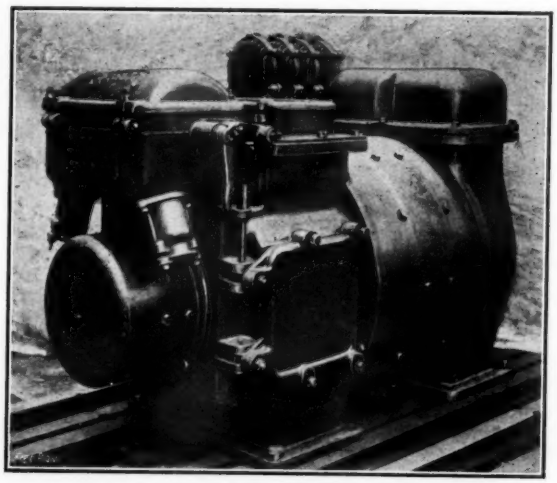


Fig. 8.—Winch Motor and Controller.

Under conditions of overload the small armature does not impart opposition pressure, so the maximum current passes through the field windings. The torque, therefore, reaches its maximum, but the motor's demand on the generator on those occasions is at a minimum. The conditions then have resemblance to the case of a stalled steam engine.

Advantages for Marine Work.—The motor controls are extremely simple, robust, and fool proof, and the manner in which the constant-current motor deals with refractory and apparently run-away loads is astonishing to one accustomed only to the behaviour of the more usual types of electric motor under like conditions. In the case of capstan motors the pull on the hawser is applied without jerk, or overstrain, and is maintained with confidence on stationary armature. The winch motors are well adapted to get the cargo out of the hold with that easy cushioned pull suggestive of a steam-driven winch, but the motor has the advantage of being clean, cool, noiseless, and capable of much greater speeds when the load is on the rise. The virtues of constant-current motors are perhaps most appreciated on the windlass drive: in this case it may be necessary to keep a stress on the anchor until it pulls out of a bed of clay, and then to haul it in rapidly and hold it until secured at the hawse pipe. In the first part of the process the load on the generator decreases as the pull on the cable increases, and when the anchor is above the surface it may be held with the brakes off and with only a nominal load on the dynamo.

For the larger applications in which magnetic brakes are necessary to supplement stationary torque they are controlled by cam-operated switches in the same manner as the by-pass main-motor switches. A notable feature of the electrical control is that changes are affected by very small steps in voltage: as there is only 0.5 volt difference between adjacent contacts, there is no sparking, or burning, of metal and the circuits are not broken, but are merely changed in value over a range of 0 to 10 volts.

Although live parts are guarded with all the precautions specified by Lloyds' Regulations (which permit a maximum of 650 volts on such systems) it has been found that live parts can be uncovered and touched with perfect safety. The system has no earth return, so contact with a positive or a negative set of connections is harmless, as there is little or no chance of leakage with the class of cables used.

Arrangement of plant on the "Viceroy of India."—For the supply of power to the Austin system three motor-generators are placed on the port side of the main power room; one of the sets is shown in fig. 3 and they run at 500 revolutions per minute. The motors are of d.c. pattern, 220 volts, and each develops 230 h.p. Directly coupled to the individual motors are the constant-current generators and their exciters; each generator is of 150 kW and produces a current of the constant value of 250 amperes, the potential range being zero to 600 volts according to the load.

Fig. 9.—Two 16-ton Capstans, C.C. Motors and Reduction Gear.

The main switchboard for the control of the ship's lighting, heating, and minor constant-potential auxiliaries also contains three feed-control panels for the 220-volt motors driving the Austin plant, and alongside the main board is the compact Austin circuit control board, fig. 5. On the face of the black polished switchboard the circuits are plainly traced with raised aluminium strip. The few simple switches required are housed behind the board in a protected cubicle, and they are operated by " Y " handles on the front panel; the handles carry aluminium quadrants aligned to the diagrammatic strips, and as they are turned clearly show the actual connections.

The main constant-current circuits are arranged respectively for the following motor groups: the forward deck, the engine room, the aft deck, and the forced-draught fans. The engine-room circuit is so connected that it may be split to allow of machinery loading being put part in series (A) with the forward deck and part in series (B) with the aft deck circuits. In the event of two generators working together, should the constant-potential driving motor of one break down, or be shut down accidentally while the generators are still in series, the outgoing generator will be cut out of circuit by automatic unloading gear, while the remaining machine carries on.

The forward deck circuit supplies the combined double windlass and port and starboard capstans, which composite machinery group is of Napier make. The twin Austin motors, each of 100 h.p., are housed beneath the windlass in a self-contained chamber and communicate their power to the gearing above by short vertical shafts. The clutching arrangements are very complete and give the maximum of combinations between the motors and the two capstans and the two cable holders. The forward deck circuit also contains 12 Austin-driven specially designed Napier winches of 2, 3 and 5 tons capacity.

The engine-room circuit (A) supplies the Weir bilge pump and a Hall CO_2 refrigerator. The forced-draught circuit supplies in all six f.d. fans of Howden pattern (a group of Austin motors for these fans is shown in fig. 6) and they have Austin potentiometer speed-control switches. The engine-room circuit (B) contains a ballast pump of Weir make and a second CO_2 refrigerator. The aft deck circuit supplies 10 Napier winches of from 2 to 5 tons loading and two capstans of 16 tons capacity, each driven by Austin motors of 54 h.p. A group of four of these winches is illustrated in fig. 7, and fig. 9 shows the 16-ton after capstans.

[Correction.—With the exception of a few wire heaters in the cabins de Luxe, the heating of the entire passengers', officers', and crew's accommodation is by means of elements made by the Morgan Crucible Co., Ltd.; approximately 800 " Morganite " elements of different loadings have been installed on the vessel, of a total connected load of 550 kW.

Cables and wires made by Siemens Brothers & Co., Ltd., were used throughout the ship.—Eds., Electrical Review.]

A Kinema Installation.

Features of the Lighting and other Electrical Equipment at the new Davis's Theatre, Croydon.

THE recently-opened Davis' Theatre at Croydon is claimed to be one of the largest kinemas in Europe, and its many novel electrical features make it also one of the most interesting. The art of colour and effect lighting may still only be in its infancy, but

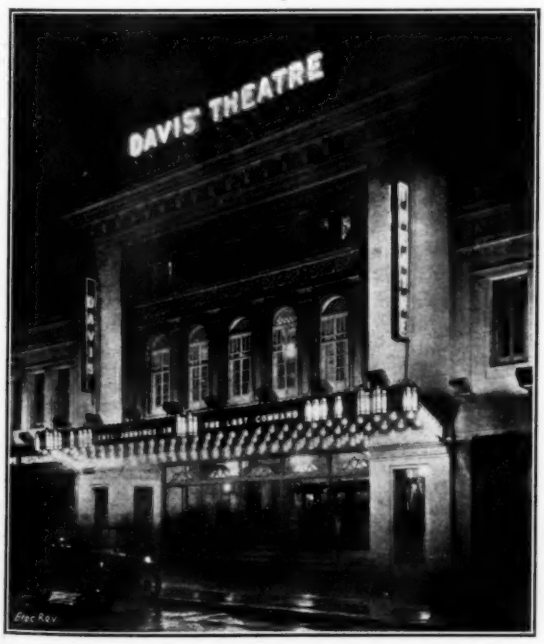


Fig. 1.—Exterior Lighting.

that distinct and creative advances are rapidly being made will certainly be immediately apparent on a visit to this kinema. It is to the initiative and careful designing of Mr. Basil Davis, Grad.I.E.E., who was responsible for the complete electrical and mechanical schemes, and under whose general supervision, Messrs. Troughton and Young, Ltd., carried out the complete installation, that this is due, and Mr. Davis is to be congratulated on the results achieved.

To describe the installation generally it may be said that a high-pressure supply provided by the Croydon Corporation is brought into a special h.p. chamber on site, where it is transformed down to 230 V, single-phase, by means of two 250-kVA transformers. The low-pressure leads are taken through a dividing wall on to the bus bars of a low-pressure open-type switchboard, consisting of eight " Sindanyo " panels on which are mounted instruments and gear for the whole of the supply to the theatre, with the exception of the secondary lighting. A d.p. 1,250-A circuit breaker controls the entire board, except the cooking panel, the whole of the load, other than cooking, being governed by a maximum-demand tariff; outgoing feeders have their own breakers and switches ranging from 750 A downwards.

In front of the switchboard, in the same room, two motor-generators are installed; these consist in each case of a Brook motor directly coupled to a Newton generator, the latter having an output capacity of 250 A at 50/80 V at a speed of 1,450 r.p.m. The motor-generators, one acting as a complete stand-by, are controlled by two d.c. panels nearby. Outgoing mains from the intake room to the various parts of the building consist of paper-insulated lead-covered cables drawn in Doulton stoneware ducts.

As regards the lighting, the auditorium has, in general, six sets of wiring, covering ordinary " white " illumination, three colour effects, and maintained and secondary lighting. The main " white " lighting scheme actually consists of " daylight " lamps mounted in the ceiling and globe fittings, and is controlled from two positions, the projector room and the stage, through a motor-driven dimmer, consisting of 10 banks in parallel on one main, mounted in a specially provided room at the back of the Royal circle, next to the projector room. The dimmers have 60 controls, and to allow for a variation in loading at any time the ten

sets have been connected in parallel and arrangements made whereby one or any number of sets may be cut out. An interesting feature is a main contactor which takes up the load just before the all-in position of the dimmers is reached, and thus provides the necessary quick-break to save the dimmer contacts. Tumbler switches controlling a contactor breaker, which in case of emergency short-circuits the entire dimmer bank, are placed in the operating room, on the stage, and at various points in the auditorium. The fittings are of the modern style employing pressed and moulded glass as the basic features of their composition.

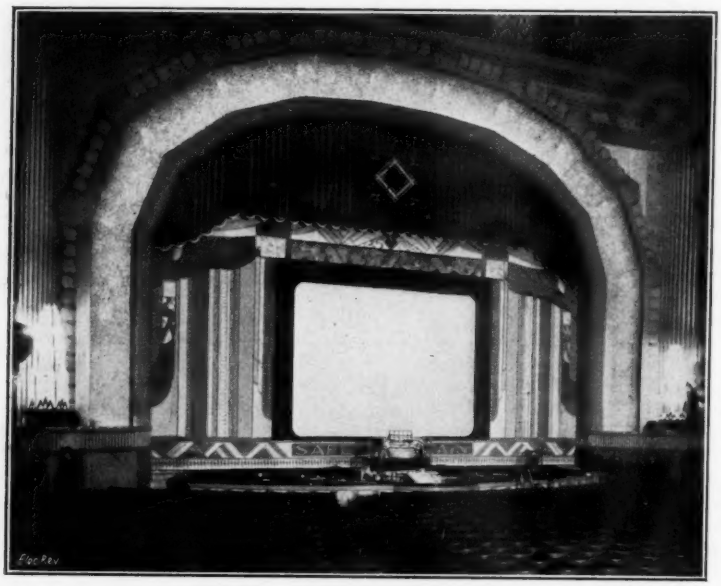


Fig. 2.—Proscenium Lighting.

Round the main and smaller domes and the proscenium arch, and in flutings at each side of the arch, cornices have been left in which special reflectors are mounted. The lamps are connected alternately to three circuits, red, green and blue. The colours were arrived at after much experiment on site. On the visible face of the domes, arch and flutings, a broken silver reflecting surface has been formed which reflects with a wonderful spectacular design of sparkle and "interest" the light falling upon it.

Every colour circuit, of which there are 26 in each case, is brought back to a switch in the dimmer room, and each colour has five main sections, each controlled by a dimmer. These sections comprise domes, proscenium, flutings (two) and fittings, and by means of the 15 dimmers thus installed, different effects are obtained on each section independently and simultaneously; these effects include any intensity of one, two or three colours in combination. No written description can convey the charm of the auditorium when a skilful blend of all the various colours is obtained. The dimmers are wound on porcelain formers and are of the slider type with master "off" control. Pilot lamps installed above each dimmer hand wheel give indication of the depth of colour during operation.

Separate circuits have been taken to each fitting and exit sign for the maintained lighting, the whole of these being brought back to the intake room and controlled on the main board. The main decorative auditorium "windows" are lit by dark-blue lamps on this system, and provide a harmonious and subdued note when the house is generally in darkness.

No alternative supply being otherwise available, the current for the secondary system is generated on site by means of two Crossley oil engines directly coupled to 6-kW d.c. Newton generators, 230 V, one acting as a stand-by. Secondary points are provided in fittings and exit boxes.

Three Gaumont "Eclipse" projectors of the very latest type are installed, and are equipped with safety devices for stopping action in the event of a film breaking or catching fire. In addition there are two spot-lights and a double-arc Stereopticon machine for slides. There is also an arc-projector chamber in the main dome of the roof, carrying three powerful projectors, and a smaller chamber at each side of the auditorium walls also carries a projector. Each of the projector machines is controlled by a flash-type white-enamelled panel equipped with double (on and off) push buttons for actuating a relay for the main lighting, an emergency short-circuiting switch, a voltmeter switch, five steps of 20 A each for the arc resistances and a switch for the motor (for the projector machines only). Four further buttons labelled, respectively, "stop," "close," "open" and "off" control the curtain motor.

Fig. 3.—General Lighting in Auditorium.

Although primarily intended as a kinema, the Davis's Theatre can be used, as its name indicates, as a theatre, and a complete stage equipment has been installed, in-

cluding battens, floats, dips and other usual apparatus. The stage switchboard is of the dead-front type, and is mounted on a gallery at the side of the stage. A single-pole clapper switch controls the whole board and is used for "black out," being operated by a small relay and switch on the centre panel of the board. Four master switches control the four colours in the floats and battens, in conjunction with metallic dimmers which are hand operated with a master control, while the dips have liquid dimmers, owing to the varying load that may be employed. The dips are connected to any of the plug boxes on the stage, each of which contains connections to the four colours. The curtain-apparatus controlled from the operating box is mounted on this switchboard gallery.

The exterior of the kinema is generally illuminated by means of 16 500-W flood lights, mounted on ornamental brackets, projecting 3 ft. 6 in. from the wall face and spaced equally distant from each other (about 15 ft. from the ground). Colour effects are obtained by the use of colour screens, and, here again, it was a matter of experiment to produce the best results. Three neon signs, one horizontal at the upper cornice level and two vertical, show the name of the building in red letters surrounded by a blue border. The upper sign is 4 ft. high and the letters, in the vertical sign are 1 ft. 6 in. high. The marquise is illuminated by 150 10-watt lamps and 90 60-watt lamps, and on the front vertical surface glass sign lettering is inserted, giving the name of the current film. The whole of the foregoing apparatus is controlled by means of a distribution board and switches placed just inside the building in the pay office.

The tea room dome consists of ornamental plaster work in the modern style, and four-colour concealed lighting in the cornice gives "effect" to the design. Dimmers are not employed, but arrangements have been made for their insertion at a later date if required. Meanwhile, very considerable variation can be arranged with the four colours, separately and in combination. "Osram" lamps are used throughout.

In accordance with the latest practice the orchestra platform may be lowered and elevated, according to the prominence which is required to be given to the artistes. This platform is operated by a d.c. motor, and to obtain the supply a Hewittic rectifier is installed which has a d.c. output of 68 A at 400 V. A further rectifier supplies current for the passenger lift in the front of the building.

For the convenience of patrons light refreshments are provided, which are produced from an electrically-equipped kitchen. Five electric urns for hot water, tea, coffee, milk and eggs, respectively, are automatically controlled to maintain a steam pressure of 5 lb. per sq. in. gauge, a main contactor being actuated through relay controls. Baking and roasting are carried out in a double-oven range which is fitted with a hot plate, and a double grill and hot closet complete the cooking apparatus. A Frigidaire cabinet serves for the necessary cooling, and washing up is done in an electrically-driven machine in which a pair of brushes revolve rapidly in hot water, the plates or dishes to be cleaned being held between them; a further hot-water sink for cup cleaning contains a revolving vertical spindle on which a number of rubber tendrils are mounted.

The auditorium is warmed and ventilated in winter and cooled in summer on the most modern "downward" system. The whole of the fresh air is introduced at the ceiling levels, whilst the vitiated air is exhausted at the floor levels, in the stalls and in the balconies. The auditorium is ventilated by means of 280 tons of fresh air per hour. This air is thoroughly washed and cooled in summer by passing it through a large chamber filled with finely-atomised water and provided with special arrangements for preventing free moisture from passing into the building. The air is warmed in winter by passing it over steam-heated batteries, the temperature of the air being controlled from a specially designed control board in the boiler room.

Steam is supplied to the air heater and the hot-water calorifier from two dry-back oil-fired steam boilers, the oil fuel being stored in two large tanks under the road adjoining the boiler house. The oil is pumped to the boilers by means of specially designed pumps, and is atomised by compressed air. The whole of the ventilating machinery, which was installed by J. Jeffreys and Co., Ltd., together with boilers, &c., is housed in a special building, detached from the main theatre building, thus minimising the risk of fire, and also risk of noise due to the single-phase motors.

The organ embodies a number of novel features, and the whole of the mechanism is electrically actuated. Some 200 miles of conductor, several thousand electro-magnets and approximately 12,000 contacts of specially-wrought metal have been used, and a 15-h.p. motor is required to provide the air. The console contains 61 note claviers and there are 260 stop-keys, crescendo pedal and toe pistons, 68 thumb and finger pistons and a pedal clavier of 32 notes. The tones of the organ enter the theatre through a grille extending the whole width of the theatre above the proscenium arch, whereby a perfect diffusion takes place and no individual department betrays its location.

A system of 30 electrically-controlled Synchronome clocks, with the master clock placed in the entrance hall, gives the time in all parts of the building, and intercommunication telephonic facilities are afforded by the standard telephone automatic instruments.

Figs. 1, 2 and 3 depict, respectively, the exterior lighting, the proscenium lighting, and the general lighting effects in the auditorium. We are indebted to *The Builder* for the illustrations.

B.E.S.A. Publications.

The 1929 edition of the index to British Standard Specifications and Reports has just been issued. It is a complete subject index which, in view of the large number (350) of British standard specifications now available, some of which include provisions for several articles or materials, will be of much assistance to those purchasing engineering and allied material, apparatus and machinery. A numerical list of the specifications is also included. The list covers 33 pages, and shows the wide range of subjects covered by the British Standard Specifications. Copies of the index are available from the Publications Department, British Engineering Standards Association, 28, Victoria Street, London, S.W.1, price 1s. 2d., post free.

The Association has also recently issued a British Standard Specification for phosphor-bronze turbine blading. The requirements specified include the chemical composition of the phosphor-bronze, the method of selecting bars for the preparation of test pieces, the form of the test pieces, and the mechanical tests to be complied with. The dimensions of the bars are not standardised. Copies of the specification (No. 352-1929) may be obtained from the Publications Department of the British Engineering Standards Association, 28, Victoria Street, S.W.1, price 2s. 2d., post free.

International H.P. Conference.

It is announced that the International High-pressure Networks Conference will hold its fifth session in Paris between June 6th and 15th. At the 1927 Conference, 28 countries and 544 members from all parts of the world met together. Both French and English will be used for the reports and discussions at the Conference, which will be attended by representatives of makers of machinery, contractors for central stations and networks, producers and distributors of electricity, professors, consulting engineers, and State engineers. At the close of the session two excursions will be made, one to the Pyrenees, and the other to Alsace and the Jura. Further information may be obtained from the secretary, Mr. Tribot-Laspiere, 25, Boulevard Malesherbes, Paris. France.

Changing Over to A.C.

Notes on the methods of dealing with consumers' apparatus and service equipment adopted by a large electricity supply undertaking during the alteration of the distribution network from the d.c. to a.c. system.

By R. H. RAWLL, A.M.I.E.E., A.M.I.Mech.E.

THERE are many supply undertakings at the present time changing-over parts or the whole of their networks from direct to alternating current. This, in itself, is, of course, no new departure; but, whereas when such a change-over was undertaken a few years ago, very little consumers' apparatus was affected, apart from motive power (assuming the supply pressure remained unaltered), nowadays, since electricity is utilised for such a variety of purposes and in so many different ways, the work involved and the organisation necessary is very considerable when any alteration in the system of supply takes place.

It is not proposed to deal here with the difficulties from a distribution point of view of a change-over from direct to alternating current. This alone is a problem of considerable magnitude, and requires very careful thought and preparation; amongst other things, it is very essential that reliability of supply is ensured to all consumers throughout the whole of the critical period, during which the various lengths of distributors, corresponding to streets, are being changed from the one type of current to the other. The author, however, has recently been responsible for the necessary alterations to consumers' installations and service equipment, consequent on a change from 220/440 volts, 3-wire d.c. to 230/400 volts, 50 cycles, 3-phase a.c., in several areas of a large supply undertaking, and trusts that a description of some of the methods he successfully employed will not only be of interest, but, will also, perhaps, be of some assistance to other engineers engaged on similar work.

(a) Administration and Organisation.

By far the most important and greatest amount of work involved in a change-over is the necessary preparation and organisation, so that on the day an actual change is effected everything goes through without a hitch and with as little inconvenience and interruption of the supply to consumers as possible.

With regard to any particular area to be changed over to a.c., it is a good plan to divide this into sections, each corresponding as far as possible to the district fed by a particular static step-down sub-station or kiosk. Everything must be in readiness for dealing with the whole of a section before any portion of it is touched. In order that everything may be cut and dried, good staff work is essential. This means that close co-operation and conferences between the various departments concerned of the supply undertakings, such as sub-stations, mains, installation, meters, accountant, &c., are highly important. When changing a section of the network to a.c., since reliability of supply is the main consideration of all supply engineers, the various lengths of distributors should be changed-over in quick succession. Apart from unavoidable delays, due to alterations to and provision of network boxes, feeding points, cable work, &c., it is a good plan to tackle a portion of the section, if possible, every other day. This gives one a whole day to clear up and settle the various new points and details, which invariably crop up during the preceding day when the actual change took place, besides presenting an opportunity for final preparations and instructions for the next length of distributor to be taken in hand on the following day.

When a supply undertaking decides to alter the system of supply in any of its areas, it applies to the Electricity Commissioners for the necessary sanction, and usually a legal notice to this effect appears in the local Press, giving details of the roads affected, &c. If the Commissioners give their consent to the proposed change-over, they usually impose several terms and conditions, one of which is that the undertaking shall make the necessary alterations to consumers' apparatus or else pay compensation for loss of use of same occasioned by the change in current. The apparatus so affected is limited to that found connected to the supply mains or in use on the day written notice is given to the consumer of the intended alteration in the system of supply. In order to prevent a consumer from being unduly penalised with regard to installing new plant, which would be affected by the change in current, such as motors, &c., the notice given must not be more than six months. The necessary consent from the Commissioners having been obtained, a representative calls at the premises of each consumer in order to take particulars of the installation and to serve the notice referred to above. Care must be taken, however, that a call must not be made until it is definitely ascertained that the supply to the premises in question will be changed-over within six months.

A list of the consumers in any particular road or street, of course, can be obtained from the records of the undertaking, but in the case of those districts where a large number of new consumers are being connected daily, if such a list is relied upon, a few services may be overlooked. The author, therefore, arranged for a call to be made at every house in each road. Incidentally, it was found that in many cases where gas was used solely for lighting and other purposes, inquiries were often made as to the possibility of an electricity supply being available, its cost of installation, &c. Thus, if the right man is put on this work, quite a number of new consumers can be obtained, and, in addition, it often forms a good opening to explain the advantages of cooker hire schemes and the provision of power plugs in the various rooms, &c., to the existing consumer, who at present only uses electricity for lighting purposes.

The representative is provided with a book containing 100 notices in duplicate, one of which is left with each consumer. The notice reads as follows:—

ALTERATION OF SYSTEM OF SUPPLY.

Dear Sir (or Madam),

It is proposed to change the system of supply to your premises from direct to alternating current within the next six months.

In addition to the lighting, the following particulars of your installation have been noted:—

The Department will make arrangements to ensure that you are given the same facilities with the above apparatus, but will not be responsible for any additional appliances installed after this date.

Yours faithfully,

For Departmental use only—Service details:

A carbon paper is inserted between each duplicated notice, and, on calling at a house, particulars of all

apparatus installed, including their current consumptions, are written down in the blank space provided. If there are no appliances apart from lighting, the words "lighting only" are inserted. Opportunity is also taken, as a check on the undertaking's records, to obtain particulars of the service cut-outs, the size and polarity of the cable, and the size and number of the meters, with their respective tariffs, all of which are put down in the appropriate space provided at the foot of the notice.

The original notice, being perforated, is torn out and handed to the consumer, the duplicate remaining in the book for the use of the supply undertaking. For convenience sake, the original is coloured white, while the duplicate is orange in tint, so that no mistake is made about where to insert the carbon paper; by this arrangement the representative always knows he must write on white paper.

The value of this method is twofold. In the first place, since the male element of the family in residential districts is usually out when the call is made, experience shows that ladies often omit to show, or forget the existence of, appliances other than those stated in the notice. Consequently, when the head of the house returns in the evening and the notice is shown to him, if any item has been omitted, he very quickly informs the supply undertaking of this. In such a case a further call should be made at once, in order to ascertain that the article in question is *bôna fide* in commission and has not been "planted." The addition is then entered on the consumer's notice and initialled, and the corresponding entry is made in the book of duplicates. Secondly, when the change-over actually takes place, should any dispute arise as to a piece of apparatus affected by the change in current not having been altered to suit the new conditions of supply, the consumer is referred to the absence of this item on the notice, which was handed to him when the particulars of his installation were taken, the copy of which the undertaking has in its possession.

It is also very desirable that all items of the installation should be demonstrated in operation before the representative and in the presence of the consumer, any defects being noted against the particular appliance in the notice. This is most important as regards apparatus not affected by the change-over. Take, for example, a radiator. If, when the change is effected, the consumer reports that the element has been burnt out, unless the above precaution has been taken the supply undertaking cannot prove whether the change in the current caused the trouble or not; and, consequently, has to give the consumer the benefit of the doubt by supplying a new element.

It may be argued that all this work takes time. It does, but, on the other hand, since the system outlined above constitutes a square deal between the consumer and the supply undertaking, the actual change-over takes place smoothly and efficiently, with very little unpleasantness on either side, and is, consequently, well worth the extra work involved. Also, it is surprising, if the right man is chosen, how quickly these house-to-house calls can be made.

In residential districts several houses will be found closed and empty during the day, and in these cases a letter should be sent to the consumer explaining the purposes of the inspection, and a request made for an appointment when the premises will be open. This often means calling in the evening, which is unfortunate for the representative of the supply undertaking. Even when access to the premises has been obtained during the daytime and the installation duly inspected, it is often necessary to make a further call after office hours, in order to interview an enthusiastic wireless amateur, whose requirements as regards supply to his apparatus sometimes cannot possibly be ascertained without a personal explanation from the owner.

The information contained on the duplicates of the notices served on the consumers is then entered into a special book, a specimen page of which is shown in fig. 1. The services to the consumers are arranged in numerical order as regards house numbers in a particular road. This book constitutes a complete record of all work carried out in the change-over from start to finish.

The particulars of load connected and the polarity of each service are sent to the mains engineer for his information, in case he wishes to make any alteration with reference to the balancing of the network when the change to a.c. takes place. Reference is made to the records of the accountant's department with regard to the tariff of each meter. The size of the new a.c. meters and the rates charged are then entered in the appropriate columns, and the list is sent to the meter-issue department, together with the numbers of the old d.c. meters which are to be replaced. Opportunity is also taken of re-arranging any service gear, and a note is made to that effect under the appropriate heading for future guidance.

STREET —

CONSUMER	ADDRESS	SERVICE CABLE		CUT-OUTS		METERS						LOAD DETAILS	APPARATUS INSTALLED BY DEPARTMENT	APPARATUS RETURNED TO DEPARTMENT	SATISFIED	REMARKS	DATE OF CHANGE OVER
		SIZE & TYPE	POLARITY	D.C.	A.C.	D.C.		TARIFF	A.C.								
						No.	SIZE		No.	SIZE							

Fig. 1.—Specimen Page from Change-over Record Book.

Then comes the most important item of all, namely, the alterations necessary to the consumers' apparatus rendered inoperative by the change in current. Quotations have to be obtained from the various makers of the different d.c. appliances for the conversion required for working on a.c. The maker of particular d.c. apparatus should, if possible, always be approached, in order that he may retain his goodwill with his customer. This procedure, of course, is always subject to a reliable article being available and a fair price being quoted for the a.c. model. In passing, it may be observed that on more than one occasion when a small motor was driving a machine, the makers have asked an outrageous price for the a.c. replacement, and when it has been pointed out to them that the supply undertaking could fix and supply a similar motor at a much reduced figure, the invariable reply has been that the complete machine was under their guarantee, and that if such a course was adopted, the guarantee would be withdrawn. Naturally the consumer objects, and the supply undertaking, not wishing to be saddled with such a liability, particularly if the machine is of an intricate and specialised nature, has to agree to the demands of such profiteers. This, of course, is not playing the game. In addition, firms quoting for the alteration of d.c. apparatus to a.c. working should always be asked to make an allowance for the old d.c. equipment.

The necessary apparatus having been ordered, it is held in readiness until the date of the change-over. In some cases, however, the existing apparatus has to be returned to the makers for alteration, and although

this can usually be arranged with a domestic consumer without any great inconvenience, as regards business premises, it is sometimes necessary to arrange a temporary loan of d.c. apparatus while the consumer's own appliance is being altered to work on a.c.

In most cases consumers prefer to have their apparatus altered for use on a.c. by the supply undertaking. There are, however, a few who wish to do this themselves, the supply undertaking paying the cost of the job. The amount quoted in such cases should be carefully examined to see that it is not excessive, and any payment made by the undertaking should be subject to a proviso, in writing, to the effect that the consumer takes full responsibility for the satisfactory working of the apparatus under the new conditions of supply, and that no other claim in respect of this can be entertained or considered.

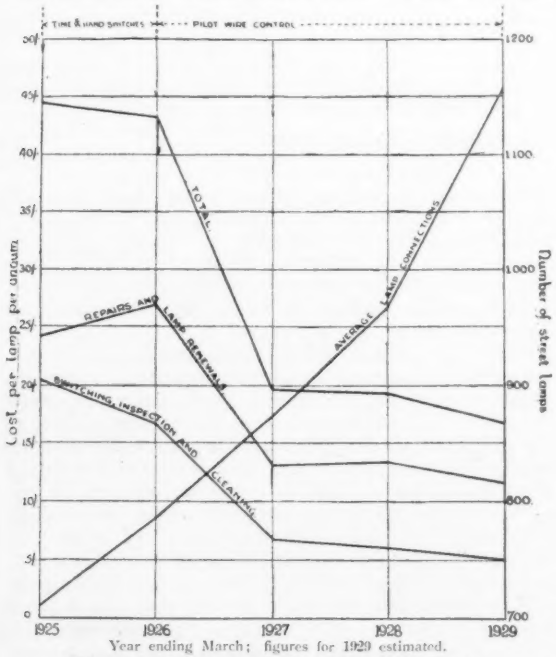
The connection of new consumers has, of course, still been taking place while the above work has been carried out, and all these must be served with the usual notices, and their names, &c., added to the list in the change-over book. *(To be continued.)*

Pilot-Wire Street Lamp Control.

Relay control of the street-lighting system at Southend has resulted in a saving of £1 5s. per lamp per annum.

By A. C. JOHNSON, A.M.I.E.E.

THE electrical power engineer must be credited with having produced many ingenious devices for the automatic or remote control of almost any kind of machinery connected with the generation and distribution of electricity. He has, however, given little thought to the control of street lamps, and many undertakings still resort to lamp-lighters, who may be seen switching on street lamps in broad daylight in order to complete their rounds before dusk. Further, many undertakings have installed time-switches, and some have reverted to hand control, pending the advent of something better.



Year ending March; figures for 1929 estimated.

Fig. 1.—Southend P.L. Operating Costs.

We hear of special mains for street-lighting purposes, which involve heavy capital expenditure and, to be effective, should consist of three-core cables—one for the ordinary lamps, one for the all-night lamps and a common return. If the common return is not provided, each lamp service will entail a joint on the main distributor as well as on the street-lighting main. Special mains may be extended indefinitely by means of relay contactors, and thus a large district may be controlled from one point. In addition to high initial cost these have two serious disadvantages: a fault on the mains is liable to leave large districts in darkness; and the lamps at the extremities of the special mains suffer from bad pressure.

The millennium of the lighting engineer will be reached when he can obtain perfect wireless control. Several experiments are being made with light rays or ripples for controlling street lighting, but it is probable that such methods will be costly and unreliable for many years to come.

Another method of control is the pilot-wire system, and it is possible that the ultimate solution lies in that direction. Pilot-wire control enables the switching of lamps from one or more control stations at a moment's notice, a feature which is invaluable, especially in case of fogs. The bugbear is the cost of laying the pilot in made-up streets. It is generally agreed that once installed the pilot wire ensures maximum service at minimum operating cost, but it is too often condemned in advance, without weighing the *pros* and *cons*, because of the pilot wire itself.

It is unfortunate that the pulling up and reinstating of made-up streets is so costly, but once laid, the cables will last a lifetime, whereas time switches have a very short life and require constant attention for maintenance and repairs. The first cost of the pilot wire is not always heavy, and in many cases it is even less than that of a time switch, as will be seen on perusal of the accompanying table. In Southend, several disused telephone and arc-lamp cables were brought into commission, and some pressure pilots were used for the dual purpose of switching the lamps off during the daytime, and of indicating feeder pressures at night. Full use was also made of any available underground ducts.

The table gives the approximate first cost and annual cost of the installation of pilot-wire control per 100-W street lamp, with a spacing of 50 yards. There has been some controversy regarding the use of plain lead-sheathed cables suitably braided and compounded for protection from chemical action. This is certainly a case for the advocates of lead-sheathed cables laid direct in the ground, seeing that the worst that can result from mechanical injury to the cable is the lighting up of the street lamps during daylight hours.

	Cost of pilot wire laid.	Cost of switch-gear.	Loan charges on cables at 7.1%.	Loan charges on switchgear at 10%.	Total annual charges
Bare overhead wires	£ s. 1 5	£ s. 1 10	1/9	3/-	4/9
Pilot incorporated in lighting cable ...	0 10	1 10	9	3/-	3/9
Lead-covered pilot laid in open trenches ...	1 19	1 10	2/9	3/-	5/9
Armoured pilot laid in open trenches ...	3 8	1 10	4/10	3/-	7/10
Armoured pilot laid in unmade roads ...	4 10	1 10	6/5	3/-	9/5
Lead-covered pilot laid under slabs ...	7 5	1 10	10/4	3/-	13/4
Armoured pilot laid under slabs ...	8 14	1 10	12/5	3/-	15/5

The attached graphs, fig. 1, show the Southend operating costs for gasfilled lamps, and it will be seen that the introduction of pilot-wire control in 1927 has effected a saving of 25s. per lamp per annum, which saving far exceeds the annual loan charges on cables and switchgear. In addition, there is a saving of over 20 per cent. in power, as the lamplighters used to take at least 1½ hours on each of their rounds.

Several undertakings have installed pilot-wire control in which the contactor or relay coils are energised in order to switch on the lamps. Three years ago Southend installed a different system in which the relay coils were energised in order to "switch off" the lamps. The difference between the two systems of pilot-wire control is very important. In the Southend system, an earth or open circuit on the pilot wire automatically switches on the street lamps; in the other a fault is liable to plunge whole districts in darkness. Another feature of the Southend system is that three classes of lamps—dusk to midnight, dusk to dawn and midnight to dawn—can be controlled by means of one pilot wire. There is no other system in use in this country which combines the two qualities of reliability and flexibility.

The following is a brief description of the Southend system:—A small combined relay switch and fuse of small dimensions is inserted in each switch casting usually provided on side-street lamp columns, fig. 4. For larger lamps, a contactor is fitted in the base of the lamp column. All the solenoids of the relays and contactors in one pilot-wire circuit are connected in series across the supply mains, as shown in fig. 2. Less than half-a-watt is required to operate a relay of 750 W capacity, so that with one class of lamp only in use and a line resistance of 50 ohms, 400 lamps can be switched off on a 230-V network. Each pilot-wire circuit can be extended indefinitely by means of automatic sub-control boards. An automatic main control board for nine piolt-wire circuits is shown in fig. 3.

The electric water heater of the storage type forms a very useful load for electricity supply undertakings, because of its good load factor. If the supply to the heater is cut off during station peak loads, its value is very much enhanced, especially in these days of bulk supply. The pilot-wire control provides a very simple and inexpensive way of carrying out this desirable operation. Two wires are incorporated in the consumer's service cable at a cost of a few shillings, and a relay of the reverse type to that made use of for street lighting is fixed on the consumer's premises with its solenoid wired in series with the solenoids in the street lamp relays. When a current is dispatched through the pilot wire, the consumer's relay connects the supply to the water heater. A useful feature of the system is that when an open circuit occurs on the pilot wire, the heaters are automatically cut off and, therefore, they will never be in use during lighting-up hours. Such a consumer will never incur kW charges, and he can, of course, be supplied at a very low rate per unit. This feature of the system, of course, touches on the important question of improving the load factor, and is worth the consideration of supply engineers.

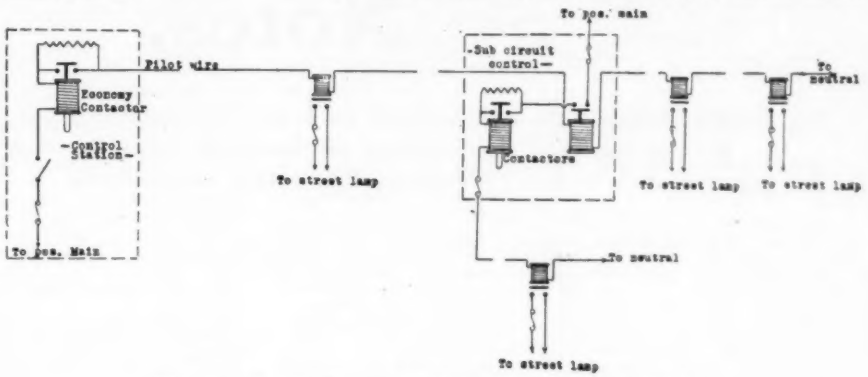


Fig. 2.—Connections for Pilot-wire "Off" Control.

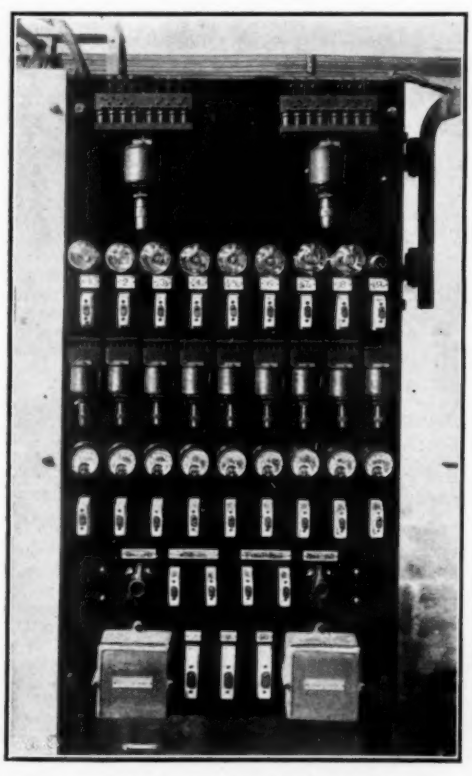


Fig. 3.—Nine-way Pilot-wire Control Board.

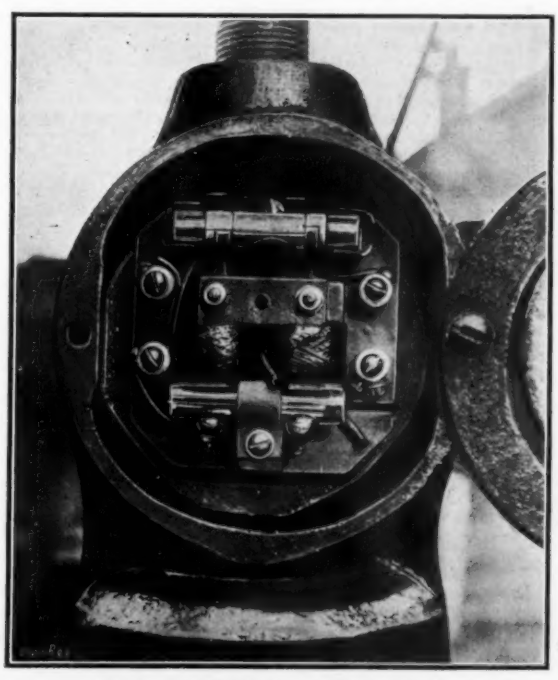


Fig. 4.—Housing of Relay Unit.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments. Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

Further Central Board Contracts.

Following upon the recent announcement by the Central Electricity Board of the placing of contracts to the value of £3,000,000 (Elec. Rev., March 15th, p. 470), the Board states that further orders to a total value of about £1,500,000 have been given out. These are as follows:—

South-East England Scheme.—66-kV and other transformers in the London area: the Hackbridge Electric Construction Co., Ltd.; the British Electric Transformer Co., Ltd.

Central England Scheme.—132-kV transformers: the British Thomson-Houston Co., Ltd.; the British Electric Transformer Co., Ltd.

North-West England Scheme.—(1) 132-kV transformers: the British Electric Transformer Co., Ltd.; the British Thomson-Houston Co., Ltd.; Ferranti, Ltd.

(2) 132-kV outdoor switchgear: Ferguson, Pailin, Ltd.; the Metropolitan-Vickers Electrical Co., Ltd.

The Treatment of British Tenders in Australia.

Considerably increased attention has been directed to the subject of Australian trade by reason of the visit of the Economic Mission from this country. But some of the Australian publicists are not allowing the grass to grow under their feet while waiting for some practical results to appear as the direct outcome of the Mission's report. For example, the *Industrial Australian and Mining Standard* of February 14th devotes a good deal of space to reasons why British manufacturers have failed to take advantage of opportunities to tender for railway supplies. It seems that Mr. Groves, the Victorian Minister of Railways, has referred in public with "amazement" to the "apparent apathy" exhibited by some British firms in this connection. Our contemporary says that those interested in British production have been frequently "amazed" to find how scant a proportion of Australian business they have from time to time received in comparison with the success of foreign tenderers. And that they have had, in the past, very substantial cause for their surprise is illustrated by certain facts and figures which are reprinted showing that some years ago the Department habitually placed contracts up to £40,000 with foreign firms "without bothering to call for tenders at all." Our contemporary's exposure of this practice in 1912 evoked definite promises of reform, and of fairer treatment to British kinsmen, but the question is again raised as to whether the old system still exists.

"Mr. Grove's 'amazement' suggests that it may still, partially, at least, survive. Than the typical present-day British manufacturer there is no man keener to secure any business that is offering in the Commonwealth. When we hear, then, that the manufacturers of Britain generally are apathetic in tendering for Victorian Railway supplies, it is difficult to avoid the suspicion that recent experience has warned them against being unduly optimistic or eager in tendering."

In Governmental and municipal tendering, Australia is gaining an unenviable reputation in England. "British manufacturers have only too often found themselves, when they have tendered, covertly and most unfairly exploited in the interests of local or foreign competitors. . . . Unhappily, similar miscarriages of justices still occur. During the past eighteen months, indeed, several cases have been reported of British tender prices and quotations having been revealed to their competitors with a view to a revision of the latter's terms. And there is another aspect which should not be overlooked. It is extremely doubtful if we ever get the whole truth regarding the many disadvantages under which the British tenderer is placed. Britain is very far away, and the local agents of her manufacturers are seldom in a position to protest effectively, or to make sustained protests, because, under their agency agreements, the onus of any complaints they might advance concerning local conditions which they may find oppressive or unjust would perhaps be cast upon them personally. This, of course, is a matter that can only be remedied by the manufacturers of Britain, who, we think, should take more interest in selling conditions here, and cease demanding an impracticable and thankless service from their local selling agents. We hope to see this remedied after Sir Arthur Duckham and his colleagues report to the proper authorities in Great Britain."

Employment during February.

The March *Ministry of Labour Gazette* states that employment in the engineering industry improved a little during February, but was still very slack on the whole; it remained fairly good in electrical engineering. Compared with a year ago there was a decline in all sections, the falling-off being most marked in marine and constructional engineering. The number of unemployed in the engineering industries as a whole on February 25th was 90,577 or 9.3 per cent. as compared with 9.6 per cent. in January and 8.8 per cent. in February, 1928. In the electrical engineering section the number was 4,289 and the proportion was 5.4 per cent. against 5.3 per cent. in January and 4.8 per cent. in February, 1928. The number of unemployed in the electrical cable, wire and lamp manufacturing group was 5,583, and the respective percentages were 6.5, 6.1 and 6.1 per cent. The electrical wiring and contracting industry reported 1,194 unemployed, or 7.7 per cent., as compared with 7.8 per cent. in January and 8.1 per cent. in February, 1928.

Moroccan Electrical Imports.

In a recent D.O.T. report upon the economic situation in the French Zone of Morocco, the British Consul-General at Rabat shows that in 1927 dynamos weighing 194 metric tons and valued at 1,893,000 fr. were imported into the Zone, mainly from France and Germany. In 1926 the weight was 470 tons and the value 4,139,000 fr. Insulated wire and cable was imported (mainly from France) to the extent of 414 tons, valued at 3,801,000 fr.; as compared with 360 tons (3,481,000 fr.) in 1926.

Electrical Prospects in Bolivia.

A report upon economic conditions in Bolivia has been prepared for the Department of Overseas Trade by Mr. A. W. Robertson, vice-consul at La Paz (Stationery Office, 1s. 6d. net). In the course of this it is stated that proposals are actively under way for making available a general supply of hydro-electric power throughout the country, which should assist greatly towards increasing the mineral production of Bolivia. The demand for electrical equipment, such as motors, transformers, transmission line material and domestic appliances of all kinds, is very likely to be stimulated by the proposed increased supply of electricity and the probable lowering of charges in the larger towns. The demand for stoves and cookers, in particular, is increasing on account of the lack of fuel, and owing to the fact that the public is becoming more educated to their use. Generally speaking, German and Swiss goods are able to compete with American and British products in price, but by no means in quality. Statistics given in an appendix show that in 1927 the imports of "electrical machinery and apparatus for generating light or illumination" amounted to 630,714 kg., valued at 1,040,702 bolivianos (about £78,000), as compared with 805,177 kg., valued at 1,194,282 bolivianos (about £90,000) in 1926. At the same time, imports of "electrical machinery and apparatus for telegraphy" fell from 91,432 kg., valued at 178,431 bolivianos (£13,400) to 3,301 kg., valued at 13,885 bolivianos (£1,000). Great Britain ranks second to the United States in the general import list, but is by far the largest customer for Bolivian products. In this small market business with old-established importing houses is recommended rather than the appointment of an agent.

Great Britain's Radio Exports.

The *Wireless Trader* recently published statistics of our exports of radio apparatus during last year. The total value (excluding re-exports) was £1,109,555, as compared with £1,203,856 in 1927. Although Australia was again the most important market, its share fell from £211,392 to £150,847. The Netherlands market was the second in importance, and in this case the share rose from £80,478 to £89,731. France came next with £75,234, against £45,722 in 1927. Other leading customers were India and Burma, £63,895 (against £86,203); Japan, £51,779 (against £197,297); and the Irish Free State, £51,530 (against £34,526).

Book Notices.

"The Anglo-American Year Book, 1929" (552 pp.). London: The American Chamber of Commerce. Price 15s. net.—This useful publication treats of all phases of Anglo-American relationships—political, financial, commercial, literary, &c.—and has been brought up to date. A special feature is the alphabetical commercial directory, containing the names of firms, agents, branches, &c., which should be valuable to all engaged in transatlantic trade. Anglo-American trade during 1928 is again reviewed by Mr. Alfred Nutting, and among the new sections is one dealing with "United States Income Tax Affecting British Companies."

"Industrial Electric Heating" (E.D.A. 696). Prepared by the E.D.A. Industrial Electric Heating Sub-Committee and edited by Mr. S. E. Monkhouse, M.I.E.E., this pamphlet is a reprint of the paper read at the World Power Conference, Fuel Conference, 1928, and gives particulars of a number of industrial electric heating applications in use in Great Britain. Members of the Association can obtain further copies at 9d. each.

"Automobile Storage Battery: Its Care and Repair," by O. A. Witte. Copies of this book are obtainable from Fredk. J. Gordon & Co., Ltd., 92, Charlotte Street, London, W.1, agents for the Ambu Engineering Institute of Chicago.

"Economic Conditions in the Republic of Nicaragua," by H. S. London (Chargé d'Affaires at Managua), and "Economic Conditions in the Republic of Guatemala," by W. M. Carse (Vice-Consul, Guatemala City). (Department of Overseas Trade). Stationery Office. Price 1s. 6d. net.—There is little of electrical interest in this combined report. In both cases the small import trade is dominated by the United States.

"Power Resources of the World (Potential and Developed)." Compiled by H. Tingley, for the International Executive Council, World Power Conference. Pp. xii+170. London: World Power Conference. Price 21s. net.

Handbook series of the U.S.A. Bureau of Standards, No. 4—Discussion of the National Electrical Safety Code (to accompany the 4th edition of the code), September, 1928 (price $1.00).

"Steam Turbines," by J. A. Moyer. Pp. 10+557; figs. 231. Price 22s. 6d. net. "Industrial Carbon," by C. A. Martell. Pp. 410; figs. 89. Price 21s. net. London: Chapman and Hall, Ltd.

New Catalogues and Lists.

Mr. ALAN WRIGHT, 124, Chancery Lane, W.C.1.—A booklet describing "Inventum" water-heating apparatus, with illustrations and prices.

MESSRS. HOPKINSONS, LTD., Huddersfield.—List No. 2120, illustrating and describing the company's "Fullbore" parallel slide valve.

MESSRS. BERTRAM B. FENN, LTD., 78-80, Edgware Road, W.2.—A booklet advertising the "Fenbo" anti-dazzle and fog-penetrating automobile lamp. Priced.

N.I.A. LIGHTING, LTD., 57-58, Wells Street, W.1.—A catalogue containing illustrations, particulars and prices of alabaster and glassware electric lighting fittings.

THE WALKER ELECTRICAL SERVICE, Annandale Street, Edinburgh.—An illustrated reprint of an article describing the firm's electrical repair workshops.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—The "Osram-G.E.C. Bulletin" for March, containing articles on the lighting of the Thames Embankment and other "Osram" installations, and notes on "Gecophone" apparatus and other of the company's products.

THE ELECTRIC ELEMENTS CO., 39, Arkwright Street, Nottingham.—A price sheet of "Elko" earthing clips of various patterns.

Electrical Imports into British Guiana.

Commerce Reports states that during the first ten months of 1928 electrical apparatus valued at $93,041 was imported into British Guiana. Of this, the United States accounted for $43,668, Great Britain for $25,753, and Canada for $12,235. In 1927 the total was $43,937, of which Great Britain provided $20,649, the United States $20,196, and Canada $1,525. The 1928 figures include certain plant which was not taken account of in previous years. The imports during the first half of 1928 were particularly high on account of the renovation of the power plant of the Demerara Electric Co., Ltd.

The American Radio Industry.

It is estimated that there are now over 1,200 factories in the United States devoted exclusively to the production of radio sets and accessories and that 320,000 people are engaged in the industry.

Bids for Shanghai Electricity Undertaking.

The Shanghai Municipality (as we have already reported) is desirous of transferring its electricity undertaking to private enterprise, and several tenders have been received. The highest offer is that of the American and Foreign Power Company, New York, which bid over ten millions sterling. The British Trusts Association, Ltd., London, offered approximately £6,380,000 and submitted a leasing plan. A leasing plan was also submitted by Lord Meston's group, which includes the Power and Traction Finance Co., Ltd., and the English Electric Co., Ltd. The Council is expected to come to a decision in the matter next month.—*Reuter* (Shanghai).

The committee appointed to report on the tenders has recommended acceptance of the offer of the American and Foreign Power Co., which is a subsidiary of the Electric Bond and Share Co. of New York.

Trade Announcements.

Mr. N. D. BLAGDON PHILLIPS, M.A.I.E.E., who was for 10 years with Messrs. Siemens Bros. & Co., Ltd., has been established in Vancouver, B.C., since leaving the Army, as representative for electrical equipment. A partnership has recently been formed, under the firm name Phillips-Henderson Company, for carrying on the same form of business.

Mr. M. F. CLARK, electrical engineer, of Deal, has transferred his showrooms from 126, High Street to the works in Mill Road.

The offices and stores of the STERLING VARNISH CO. have been transferred to Fraser Road, Trafford Park, Manchester. (Telephone: Trafford Park 1753-4.)

The address of DIXONIA, LTD., is now Clifton Street Works, Latimer Road, W.11. Telephone: Park 8942; telegrams: "Dixlecsund, Phone, London."

The business of J. SMITH & SON, Brighton, has been converted into a private company—J. SMITH & SON (BRIGHTON), LTD. Mr. H. L. Smith is managing director, and Mr. J. D. Smith retires from active management, but is a director of the new company.

The BRITISH THOMSON-HOUSTON CO., LTD., has opened a new "Mazda" lamp stores and trade counter at Sherwood Buildings, South Sherwood Street, Nottingham. (Telephone: Nottingham 260; telegrams: "Asteroidal, Nottingham.")

SPHINX ELECTRIC, LTD., Hatton Garden, E.C.1, announces that it has taken over the sole concession for "Quickfix" galleries and ceiling plates.

United States Foreign Trade.

A review of the external trade of the United States in 1928 has been prepared for the Department of Overseas Trade by Mr. A. J. Pack, Commercial Secretary at Washington (Stationery Office, 1s. 6d. net). The latest figures given relate to 1927, and it is shown that Great Britain is still the United States' best customer, although her share of American exports declined from 26.2 per cent. in 1910-14 to 17.3 per cent. in 1927. Before the war Great Britain secured the largest share of the import trade, the figure being 16.5 per cent. over the 1910-14 period; in 1927 both Canada and Japan supplied a greater proportion—11.4 and 9.6 per cent., respectively, as compared with 8.6 per cent. for Great Britain.

During the fiscal year 1927-28 United States' exports of electrical machinery, apparatus and supplies were valued at $87,200,000, as compared with $83,200,000 in 1926-27. The electrical machinery industry has made regular and progressive strides, although in 1927 there was a slight falling-off in production. Canada is the largest market, having purchased $18,270,000 worth of electrical machinery during 1927. Latin American countries provided a market worth $17,827,000 and Asia purchased $13,760,000 worth. Japan is the principal purchaser in the Orient. In Europe, the United Kingdom is the principal market, purchases in 1927 having amounted to $5,612,000. In the electrical machinery group the British Empire accounted for 42 per cent. of the exports.

In a report upon the American electrical industries, included in the publication, Sir J. J. Broderick, Commercial Counsellor at Washington, says that the output of electricity by public utility companies during 1927 was over 80,000 million kWh, or 676 kWh *per capita*. The total number of consumers was 21,694,000, and the average price for domestic lighting purposes was 7.3 cents per kWh. The total investment in the electricity supply industry is estimated at $8,084 millions.

Electrical equipment manufacturers, particularly those producing wire and cable, have had a prosperous year, both in their domestic and foreign trade, and their prospects for the immediate future are distinctly favourable.

Indian Duties on Wires and Cables.

Our Indian Correspondent states that the Indian Tariff Board has now issued its report on the question of tariff equality in respect of the manufacture of electric wires and cables. It recommends that the duty on electrolytic copper rod known as "black rod" be removed, and that a duty of 5 per cent. be levied on rubber-insulated electric wires and cables other than those specified in article 30a of the tariff schedule. The report observes that the present revenue policy of the Government of India is responsible for the existing inequality in tariff treatment between the Indian Cable Company and its foreign competitors. The imported wires and cables of the sizes generally used for industrial purposes are admitted free of duty, while the company is required to pay duties ranging from 5 per cent. to 30 per cent. on a large proportion of the raw materials used by it in the manufacture of wires and cables. The result is a clear case of tariff inequality handicapping a domestic industry in competition with foreign manufacturers. A disadvantage which has incidentally resulted to the company from the removal of the duty on imported wires and cables is the reduction in orders for repairs and urgent replacements. The business in the bazaar has been further affected recently by the importation of cheap electric wires and cables from the Continent, especially from Germany. These coming in small quantities have steadily exercised a depressing effect on the market. In view of the fact that "black rod" is not manufactured in India at present and

the Indian Cable Company is practically the only purchaser, it appears unnecessary to retain the duty in the tariff schedule. The Board does not consider a refund of duty or bounty suitable, and recommends a general duty of 5 per cent. on all class of rubber insulated cables, not less than 1/80th square inch in sectional area.

For Sale.

Mr. G. R. Lightfoot will sell by auction on April 11th, at 13, High Holborn, large stocks of electrical and wireless material. Worksop U.D.C. Electricity Department has for disposal 1,650 yd. h.p. cable. (See our advertisement pages to-day.)

Trade Delegation to Russia.

The British Industrial Mission to Russia, organised by the Anglo-Russian Committee, was to leave for Moscow on Monday last. A list of the delegates published in the *Financial News* included the following:— Mr. E. Balmford (National Gas Engine Co., Ltd.), Mr. E. M. Benjamin (Petters, Ltd.), Mr. E. L. Cadwallader (C. A. Vandervell & Co., Ltd.), Mr. F. Creed (Creed & Co., Ltd.), Mr. C. C. Day (Mirrlees, Bickerton and Day, Ltd.), Messrs. L. E. Mather and S. Jarvis (Mather and Platt, Ltd.), Mr. R. B. Lister (R. A. Lister & Co., Ltd.), Mr. H. E. Metcalf (Ruths' Steam Storage, Ltd.), Mr. L. M. Parry (Henry Wiggin & Co., Ltd.), Mr. S. W. Reeve (Reavell and Co., Ltd.), Mr. J. W. Ryan (Clayton & Shuttleworth, Ltd.), and Mr. L. H. Tomkin (Hobart Manufacturing Co., Ltd.).

It will be observed that none of the leading electrical manufacturing companies is represented, practically all of the above-named concerns being of an " allied " nature.

London Electricians' Strikes.

In pursuance of its demand that men engaged on electrical construction work must be members of the Electrical Trades Union and no other, the E.T.U. last week called men out on strike on five London undertakings last week, including the new building of the Underground Railways at St. James's Park. *The Times* says that in four of the five cases the work in progress was lift construction, which, the employers maintain, is a specialised engineering job. In the fifth case the stoppage was said to be due to the intervention of a supervisor to give instructions regarding the working of conduit.

It appears that the hourly rate for the men engaged in lift work is 1s. 4½d., whereas the rate for electricians, whom the Union say should be doing the wiring, is 1s. 9½d. The strikers have no quarrel with their employers, the electrical contractors, their action being directed purely against the lift construction firms.

On Saturday men engaged on a large block of buildings in Piccadilly ceased work for the same reasons. It was reported on Tuesday that the strikes had been " recognised " by the London District Committee of the E.T.U., but no endorsement had come from the National Executive of the Union.

Social Events.

The annual dinner and prize distribution of the cricket clubs of the concerns with which Mr. C. R. Belling is associated took place at the George Hotel, Enfield Town, recently. The firms represented were Belling & Co., " M.K." Electric, Ltd., Belling & Lee, Ltd., Insulators, Ltd., the Ro-gat Tool Co., Ltd., Wootton & Co., Ltd., and Concrete Utilities, Ltd. Mr. C. R. Belling occupied the chair, and he was supported by representatives of the various companies. The dinner was followed by a vocal and instrumental concert. A silver cup, provided by the directors, was presented by Mr. Belling to the Concrete Utilities Club.

The staff of Messrs. John Shaw & Sons, Wolverhampton, Ltd., held their annual dance recently at the Victoria Hotel, Wolverhampton. The company, numbering close on 200, included the general manager, Mr. V. A. Mattick. The presentation of a number of spot prizes created great amusement.

North-East Area E.D.A. Conference.

The third E.D.A. Conference of the session under the auspices of the North-East Area Committee was held on March 20th at Newcastle. Mr. R. E. Robson, chairman of the Committee, read a paper of considerable local interest, " The Place of the North-East Coast in the Electrical Industry, Past, Present and Future." Mr. W. F. T. Pinkney presided. There was an excellent attendance, and a good discussion followed the paper. Mr. Robson covered the whole of the electrical development of electricity in the North-East Coast area up to the present day, and dwelt at some length on the possibilities of electrical development in the future. Messrs. Falconar, Ward, Gray, Albrecht, Gledson, Adam and Miss Jackson took part in the discussion.

Sir Hugo Hirst Welcomed Home.

A " welcome home " dinner was given to Sir Hugo Hirst, Bt., by the Incorporated Society of British Advertisers at the Hotel Cecil on March 21st. Mr. F. W. Goodenough, who presided, heartily congratulated Sir Hugo and his colleagues upon the report which they had produced after their study of Australian conditions. In the course of his reply, Sir Hugo referred to the need for attracting university and public school men into business, although he pointed out that business was not merely a question of knowledge, but of judgment. He considered that Australia had not kept pace with the advance in other countries, and its contact with the Mother Country was not close enough. The Australians were anxious to be British, but they needed our constant attention. The Australian problem was the problem of the whole Empire. We must help them with British capital and keep them fully acquainted of British developments. Sir Basil Clarke, who also spoke, drew attention to the differences between British and Dominion conditions, and urged that these should be thoroughly realised and studied.

Bankruptcy Proceedings.

A. B. Gregory, 29, St. Albans Road, Seven Kings, Essex, wireless expert.—An application for the discharge of this debtor was heard on March 18th, at the Shire Hall, Chelmsford. The receiving order was made in 1928, when the statement of affairs presented showed liabilities of £418, against assets which had realised £8. No dividend had been paid. The discharge was granted subject to a suspension for six months.

C. K. Wallis, electrical engineer, late of Bedford Street and Longford Road, Bognor.—Bankrupt discharged subject to consenting to judgment for £20 and 30s. costs of judgment. (£20 paid to the Official Receiver in lieu of entering up judgment.)

P. W. Penty (Sackville Electrical Co.), electrical contractor, 38, Mannville Terrace, Morley Street, Bradford.—Trustee, Mr. J. O. Morris, 12, Duke Street, Bradford, released March 8th.

F. H. Barrell (F. H. Barrell & Co.), radio engineer and fancy goods dealer, 2a, 2b, 2c, Church Street, Staines. Trustee, Mr. T. Gourlay, 29, Russell Square, W.C.1, released March 6th.

T. F. J. Truss, electrical engineer, 28, Wincobank Avenue, Sheffield.—First meeting held March 27th, at the Official Receiver's offices, Figtree Lane, Sheffield. Public examination, April 11th, at the County Court Hall, Sheffield.

H. C. Buckley (H. Buckley), 23, Asylum Road, Old Kent Road, S.E.—Adjourned public examination held March 27th, at Carey Street, W.C.

S. Perkins, wireless dealer, 1, Lodge Lane, Beeston, Leeds.—Last day for proofs for dividend April 10th. Trustee, Mr. H. C. Bowling, Official Receiver, 24, Lower Bond Street, Leeds.

Company Liquidation.

Kye, Ltd.—Last day for proofs for dividend April 3rd. Liquidator, Mr. E. H. Hawkins, 4, Charterhouse Square, E.C.1.

Private Arrangements.

S. C. Smith, electrical and wireless dealer, 10, Facade, Devonshire Road, Forest Hill, S.E.—A meeting of creditors was held recently at the offices of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C. The statement of affairs submitted showed liabilities of £569 and net assets of £496, leaving a deficiency of £73. The business was commenced by the debtor's father in October, 1927, and was taken over by the debtor in April, 1928. As only rough books had been kept, the usual trading figures could not be prepared. The turnover had been in the neighbourhood of £30 a week, and the drawings had only been about 30s. weekly. The debtor's father had undertaken to withdraw his claim. An execution had been levied, and other creditors were pressing. A resolution was passed confirming a deed of assignment already executed to Mr. W. A. J. Osborne, and it was stated that efforts would be made to sell the business as a going concern. The following are creditors:—

	£		£
Clark & Moir	105	Foster Engineering Co.,	
Dulcetto Polyphone Co.	77	Ltd.	70
Eastick, J. & J., & Son	72	Marconiphone Co., Ltd.	28
East London Rubber Co.	26	Philips Lamps, Ltd. ...	27

Company to be Dissolved.

Clun Electric Supply, Ltd.—Reg. No. 7917 R. Salop Electric Power Station, Bridge Street, Clun, Salop. The company is to be dissolved by instrument dated March 19th, unless cause is shown to the contrary within three months.

New French Companies.

A company has been formed in Paris (12, Boulevard du Temple) with a capital of 1,200,000 fr. and the title La Société Textile Electrique to manufacture insulating material.

La Société Provinciale de Distribution de l'Energie is the name of an undertaking which has lately been organised in Lyons with a capital of one million francs.

Unemployment.

There was a decrease of 118,530 in the number of registered unemployed during the week ended March 11th. At that date the total was 1,268,800 as compared with 1,387,330 on March 4th, and 1,071,730 on March 12th, 1928.

Polish Foreign Electrical Trade.

During January last Poland imported " apparatus, conductors and other electrotechnical materials " to the value of 8,185,000 zloty (about £190,000). Polish exports of this class had a value of 85,000 zloty (about £2,000).

The British Industries Fair, 1930.

Mr. Douglas Hacking, Parliamentary Secretary to the Department of Overseas Trade, announced last week that the London Section of next year's British Industries Fair will be held at Olympia instead of at the White City. The former building is being reconstructed, and the space available will

be little less than that at the White City. The Government is again making a grant of £25,000 for publicity purposes in connection with the Fair.

New Showrooms in Limerick.

The Electricity Supply Board of the Irish Free State has acquired premises in O'Connell Street, Limerick, to be used as showrooms for the display of electrical appliances in connection with the Shannon scheme.

French Products in Germany.

The Deutsche Alsthom Gesellschaft has been formed in Berlin to market the products of the Société Alsacienne de Construction Mécanique and the Compagnie Française Thomson-Houston in Germany.

Prices of Raw Materials.

CORRECTION.—In last week's issue, page 522, the price for copper (electrolytic) bars should read £99 10s., £8 inc.

Messrs. F. Smith & Co. report, March 26th: Copper (electrolytic) bars, £112 12s. 6d.; do. do. sheets, no change; do. do. wire rods, £122 12s. 6d.; £13 12s. 6d. inc.; h.c. wire, 1s. 2 15/16d., 1 9/16d. inc.; silicium bronze wire, 1s. 3½d.; 2½d. inc.

Messrs. James & Shakespeare report, March 26th: Copper bars (best selected), sheet and rod, £138; £13 inc.; English pig lead, £28 10s., 10s. dec.

Messrs. Edward Till & Co. report, March 26th: India-rubber, Para fine, 1s. 1d., ½d. dec.

In their letter dated March 23rd, Messrs. James Forster and Co. stated that an unprecedented jump in lead prices occurred on Monday last week, the opening price being about £3 higher. This was due to speculative buying, and it was not surprising to see a drastic setback the next day of 45s. per ton. The market has since been firmer under the stimulus of the raising of the official American price from 7.25 to 7.75 cents per lb. Under present conditions of supply and demand there is no justification for the enhanced values. The rise has killed demand in this country, as consumers are naturally adverse to making any purchases at such a high figure. Supplies meanwhile are plentiful. Consumers should restrict their purchases to a minimum, as sooner or later a severe reaction will be seen to a lower level more compatible with the position of supply and demand.

Lighting and Power Notes.

Australia.—SYDNEY (N.S.W.).—The Sydney Civic Commissioners have decided to spend an additional £1,000,000 on the Bunnerong power house, which is being built to provide electricity for the whole of the metropolitan area. So far over £2,000,000 has been spent on the undertaking. At present the Sydney Council draws largely on the Railway Commissioners' plant to meet the needs of the consumers connected with its service, the cost last year being about £400,000. With the completion of the Bunnerong power house, the Council will be able independently to meet all demands made upon it for electricity.—*Reuter* (Sydney).

Aylesbury.—LOANS SANCTIONED.—The Town Council has received sanction to the following loans: mains and services, £24,271; plant (sub-station equipment), £699; domestic apparatus to be let out on hire, £9,412.

Bedford.—ELECTRICITY EXTENSIONS.—The Corporation Electricity Committee reports that it is necessary to lay cables and carry out work to allow the l.p. network to be sub-divided into smaller areas than at present. It is also necessary to provide additional transformer sub-stations in various parts of the town, most of which will be fed from a new Scott bank sub-station similar to that erected in Lurke Street. The cost is estimated as follows: Buildings, £1,450; underground mains, £4,800; sub-station equipment, £3,650.

ELECTRICITY CHARGES.—The Committee has prepared amendments to provide for a reduction in the charges for power and the introduction of an alternative method of charging for lighting, heating (except industrial heating), cooking and domestic appliances. The latter is in the form of a two-part tariff. The revisions are equivalent to a revenue of £8,300.

RURAL SUPPLY.—The Town Council has approved a scheme for supplying electricity in rural areas at an estimated cost of £100,000. The scheme provides for the supply of electricity to 31 parishes.

Canada. — HYDRO-ELECTRIC DEVELOPMENT. — The British Columbia Power Co. has awarded a contract to Messrs. Stuart Cameron & Co., Ltd., and Messrs. Armstrong, Morrison & Co., Ltd., for the construction of a dam near Ruskin, on the Stave River—the site of the company's $7,250,000 power project. Construction of the dam (which will be 180 ft. high, 350 ft. on the crest, and 120 ft. wide at the base) will commence immediately. The contract calls for completion by October 31st, 1930. Other contracts for tunnels, hydraulic and electrical machinery and power plant equipment will be let almost immediately, completion being called for by December 31st, 1930. The Ruskin development, which will be the third in the company's chain of hydro-electric power plants on the Alouette-Stave Falls (Ruskin system), will have an initial capacity of 43,000 h.p. in one unit, provision being made for the addition of another unit of the same capacity when power demands warrant. The ultimate capacity of the plant will be 173,000 h.p.

The Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has issued its annual review of the water-power resources of Canada, developed and undeveloped, as at January 15th, 1929. The total water-power resources of the Dominion are now estimated to be 20,197,000 h.p. under conditions of ordinary minimum flow, or 33,113,200 h.p. ordinarily available for six months of the year, while the total hydro-electric development at the present time amounts to 5,349,232 h.p.

Continental. — ITALY. — Among the concessions recently granted for the establishment of new hydro-electric stations in Italy is one to the Società Trentina di Elettricita to utilise the water power of the River Isarco at Bolzano. It is estimated that about 20,800 h.p. is available.

Droxford.—RURAL SUPPLY.—The Rural District Council has decided to oppose an application by the West Hampshire Electricity Co., for an Order authorising it to supply electricity in the rural area, on the ground that the company has not made sufficient provision for covering the district, and that the price per kWh (10d.) is exorbitant. The Portsmouth Corporation has already offered to supply Hambledon, and the Rural Council has consented to this proposal, and has invited the Corporation to include Soberton in the area of supply.

Edinburgh.—SUSPENSION OF SINKING FUND.—An Order promoted by the Corporation provides for the postponement of payments into the sinking fund required to be provided for the repayment of borrowed money in connection with the extension of the Portobello station for such period or periods and subject to such conditions as the Order may prescribe, and that as regards money borrowed for the said purpose the Corporation may accumulate the yearly interest thereon, and include it in the capital account until the commencement of the sinking fund payments.

Glasgow.—MAINS EXTENSIONS.—The Corporation Electricity Committee has authorised mains extensions at a cost of £5,676.

ELECTRIC WASHERS.—The Committee has instructed the manager to purchase 50 electric washers for sale on the hire-purchase system.

PROGRESS DURING FEBRUARY.—Under the Corporation Electricity Department's scheme 583 houses were wired during February, making the total to date 12,161. Hired appliances numbered 272, the total to date being 18,484.

Hornsey.—NEW PLANT.—The Corporation Electricity Committee has recommended the installation of a 300-kW motor convertor at the Highgate sub-station, at an estimated cost of £3,076, and the purchase of a Hewittic rectifying set for the electricity works at an estimated cost of £3,886.

APPLICATION REFUSED.—The Committee has been informed by the Electricity Commissioners that they are not satisfied that the Corporation would, if consent to extend its plant were given, be in a position to give an adequate supply of electricity to meet the present and prospective demands of the consumers at a cost not greater than that at which it could give it if a supply of electricity was obtained from the London and Home Counties Joint Electricity Authority. The Commissioners have accordingly decided to refuse their consent to the application of the Corporation.

Irish Free State.—ELECTRICITY SUPPLY BOARD.—The Electricity Supply Board has now given notice of its intention to acquire on March 28th the following electricity undertakings owned by local authorities: Dublin, Rathmines, Pembroke, Clonmel, Thurles and Swinford. The price of electricity to consumers will not be affected by the Board's acquisition of these concerns. Other undertakings acquired so far by the Board include Bray, Kingstown, Limerick, Waterford, Wicklow, Enniscorthy, and Edenderry. There remain in the Free State four undertakings owned by local authorities which have not yet been acquired, or in respect of which notice of acquisition has not yet been issued, *viz.*, Navan, Kildare, Dundalk, and Ballaghadereen.

QUEENSTOWN.—The Urban District Council has written to the Electricity Supply Board demanding a reduction in the charge for electricity for lighting, which is at present 10d. per kWh, failing which it proposes to ask the Ministry for Industry and Commerce to hold an inquiry into the existing scale of charges.

Lichfield.—LOANS.—The Town Council has applied for sanction to a loan of £2,990 for overhead cables to give a supply of electricity to Shenstone. Sanction has been received to a loan of £2,100 for house-wiring installations under the hire-purchase scheme, domestic apparatus for hire, and for additional testing instruments.

CHARGES FOR COOKING SUPPLY.—At Whittington, electricity is to be supplied for cookers at a quarterly charge equal to 7½ per cent. for the first £30 of the net ratable value, and 5 per cent. above, plus 1d. per kWh.

London.—Stoke Newington.—The Borough Council has received sanction to a loan of £10,000 for mains and services.

Lowestoft.—Loans.—The Corporation Electricity Committee has recommended that application be made for sanction to loans of £14,500 for the provision of main and distribution cables for the supply of electricity to premises in the parish of Kessingland, and £5,000 for meters.

Machynlleth.—Electricity Supply.—The Urban District Council after considering electricity schemes submitted by Crompton Parkinson, Ltd., and the Electric Development and Securities Trust, Ltd., has decided to ask the latter if it is prepared to proceed with the Order applicable to the town independent of the support of other authorities mentioned in the Order, and also whether in the event of sanction it would be open to the Council to arrange terms as to the overhead and underground mains.

Manchester.—Progress During January.—During the month of January the Corporation electricity undertaking showed an increase in connections of 1,842 kW, bringing the total up to 372,043 kW; and the number of applications received for supply, including those for additional supplies, was 1,221, representing a total of 3,487 kW. The number of hired cookers connected increased by 56, bringing the total of hired cookers actually on circuit to 5,081. Applications for the hire of cookers totalled 61. Additional plant was installed at five existing sub-stations. The change-over from d.c. to a.c. had been completed in the cases of 4,217 consumers, work was in progress involving 1,087 consumers, and sanction had been received in respect of an additional 658 consumers.

New Zealand.—Wellington.—The report of the manager of the city electricity undertaking (Mr. M. Cable) for the year ended March 31st last records a total revenue of £339,980, as compared with £283,554 in the preceding year. Working expenses amounted to £144,352, as against £126,500, leaving a gross profit of £195,628 (£157,054). Capital charges absorbed £71,628, and after making various appropriations there was a net surplus of £51,617, as compared with £24,031 in the previous year. The capital expenditure during the year amounted to £52,730, bringing the total spent on the undertaking to £992,196. The electrical energy sold increased from 27,162,109 to 30,212,973 kWh, and the average price obtained per kWh fell from 2.49d. to 2.09d. The maximum supply demanded rose from 11,400 to 12,910 kW.

Oxford.—Purchase of Undertaking.—The Corporation Electricity Committee has recommended that it be authorised to carry on proceedings in order to secure compliance with the notice served on the Oxford Electric Co., Ltd., requiring the company to sell its undertaking, and to engage such counsel and other expert assistance as may be required for that purpose. The Committee is advised by counsel that the Corporation will be entitled to the income and profits of the company from the date of the service of the notice to purchase, unless a different date is fixed by agreement between the parties.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

Calne.—Lighting: 7½d. per kWh, with a minimum charge of 10s. per quarter. Power: Varying from 3½d. per kWh for the first 100 kWh per quarter to 2½d. for over 400 kWh, with a minimum charge of 10s. per quarter.

Canterbury.—Heating, cooking, and domestic purposes, other than lighting: From 1½d. to 1¼d. per kWh. Large a.c. power consumers: £6 per kVA per annum, plus ¾d. per kWh, electricity used for lighting not to exceed 10 per cent. of the total consumed.

Special Orders.—Application has been made to the Electricity Commissioners for a Special Order by Electric Development and Securities Trust, Ltd., authorising it to supply electricity in the urban districts of Machynlleth and Towyn, the rural districts of Machynlleth, Ysgubor-y-coed, and Pennal, part of the rural district of Aberystwyth, and the township of Aberdovey.

The Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising the West of England Electricity, Ltd., to supply electricity in the borough of Honiton, the urban districts of Ottery St. Mary and Wiveliscombe, the rural districts of Dulverton and Wellington, and parts of the rural districts of Crediton, St. Thomas, Tiverton, Axminster, and Honiton; and Hull Corporation to supply electricity in the boroughs of Beverley and Hedon, the urban district of Cottingham, and parts of the rural districts of Beverley, Skirlaugh, Sculcoates, and Patrington.

Swansea.—Loan.—The Corporation Electricity Committee is to make application for sanction to the borrowing of £2,000 in connection with an assisted wiring scheme.

Turton.—Electrical Development.—The electrical engineer, in a report to the Urban District Council, intimates that at a later date he proposes to draw up a scheme for a better supply of electricity to various districts. This will involve the laying of about two miles of h.p. cable and installing three transformer kiosks. The total cost of this extension will be about £10,000.

Tramway and Railway Notes.

Algeria.—Railway Electrification.—Contracts have been placed for the electrification of the Duvivier-Ould-Keberif section of the railway between Bone and Tebessa. The contact lines and sub-stations will be supplied and erected by the Compagnie d'Entreprises Electro-Mécaniques, of Paris, while the electric locomotives will be supplied by the Société d'Etudes pour l'Electrification des Chemins de Fer Français.

Continental.—Switzerland.—The balance sheet of the Federal Railways for 1928 shows receipts of 170.15 million fr. and an expenditure of 152.4 million fr., leaving a profit of 17.75 million fr., the largest up to the present.

India.—Railway Electrification.—A further step has been taken in the proposals for electrifying some of the sections of the South Indian Railway. *Indian Engineering* states that the South Indian Railway administration has referred to its consulting engineers, Messrs. Robert White & Partners, Westminster, to obtain expert opinion on electrifying the following five lines including the supply of electrical energy to the Golden Rock Railway Workshops: Ootacamund to Mettupalayam, Mettupalayam to Podanur, Podanur to Dindigul, Podanur to Erode and Trichinopoly to Tanjore. Messrs. Robert White & Partners have submitted a report to the South Indian Railway which, together with the proposals of the company, have been sent to the Railway Board for sanction. Meanwhile the long expected decision of the Madras Government on the Pykara hydro-electric scheme for which estimates have been prepared is anxiously awaited by all those interested in railway electrification proposals, as energy for these schemes is proposed to be supplied by the Pykara project. Among the lines proposed to be electrified, Ootacamund to Mettupalayam is a heavy ghat line, Mettupalayam to Podanur and Podanur to Erode will be broad gauge, while Podanur to Dindigul and Trichinopoly to Tanjore are metre gauge sections. It is believed that the main transmission line supplying energy for these schemes will be the longest in the world.

Kingsnorth.—Transfer of Undertaking.—Application has been made to the Minister of Transport by Messrs. Holm and Co., Ltd., for an Order authorising the transfer to a company to be incorporated of the Kingsworth light railway. The title of the company will be the Kingsnorth Light Railway Co.

Lancashire.—Abandonment of Tramway.—A select committee of the House of Lords has considered the Bill promoted by the South Lancashire Tramways Co., to authorise it to substitute railless cars for the present tramway system. The case for the promoters was that they were under obligation to reconstruct the tramway at a cost of £57,000, and they were also faced with the problem of reconstruction of the whole of their system of over 32 miles. If the Bill was passed they would complete the conversion in five years, at a cost of £159,500. The Committee passed the Bill enabling the company to substitute railless cars, but rejected proposals that the company should no longer be required to provide lighting for its track, and for a transport monopoly. It was agreed that the County Council, where it was the road authority, might relay the track after the tramways were abandoned and charge the cost to the company.

London.—Camden Town Station.—Good progress is being made with the work of installing the twin escalators at Camden Town station. The 90-feet escalator tunnel has been bored and a circulating chamber has been excavated at the foot of the tunnel. Four new passage ways will lead to the platforms. Three of these are completed, and the other will be finished shortly. The escalators will be in service about midsummer. Camden Town will be the twenty-ninth station on the Underground system to be equipped with moving stairways, and will bring the total number of escalators up to 85.

Underground Speed-up.—The *Financial News* reports that in consequence of the growth of short-distance traffic during the midday period, the train service on the Central London Railway has been increased from 30 to 35 trains per hour during the midday period. This is the closest interval midday service ever operated on the Underground system.

Middlesex.—Light Railways.—The County Council has applied to the Minister of Transport for an Order authorising it to construct light railways in the parishes and urban districts of Tottenham and Walthamstow.

New Zealand.—Wellington.—We have received from Mr. M. Cable, general manager of the city tramway undertaking, a copy of his report, together with the statement of accounts for the year ended March 31st last. The total revenue amounted to £449,930, and working expenses were 332,467, leaving a gross profit of £117,463. The figures for the preceding year were: Income, £432,222; working expenses, £328,592; gross profit, £103,630. After deducting capital charges and a loss on the motor-omnibus service, there was a net profit of £14,367, as compared with £10,702 in 1926-27. The number of passengers carried increased from 43,963,802 to 45,413,127, and the car miles run from 4,002,448 to 4,164,829. The average receipts per car mile increased from 25.91d. to 25.92d.

Telegraph and Telephone Notes.

Canada.—TELEPHONE SERVICE.—According to a recent survey, on a per capita basis, an average of 221 telephone conversations per annum take place between telephone users in Canada, as compared with 205.4 in the United States and 137 in Denmark, which hold second and third places, respectively.—*Reuter* (Ottawa).

International Telephony.—SWEDEN AND ESTHONIA.—The new telephone line between Stockholm and Reval, *via* Helsingfors, was inaugurated on March 18th. Communication was quite successfully carried on and it is expected that the new line will shortly be extended to Latvia.—*Reuter* (Stockholm).

Press Telegraph and Telephone Facilities.—GENEVA REPORT.—The Committee of the League of Nations on Communications and Transit has adopted the reports of the Special Committee of Press Experts regarding telegraph and telephone facilities for the Press which are to be considered by the Telegraph Conference in 1930. The Committee further endorsed the recommendation of the Press Experts' Conference regarding greater facilities for communication by wire and wireless between Europe and Eastern countries and North and South America.—*Reuter* (Geneva).

The Telephone Service.—STIMULATING THE DEMAND.—Sir Alexander Roger, chairman of the Telephone Development Association, speaking at the annual general meeting in London, said, according to the *Daily Telegraph*, that the latest figures available showed that at the end of February last there were 1,742,095 telephones, which represented an increase of 124,532 in twelve months. With a view to creating the telephone habit and stimulating a popular demand, Sir Alexander urged that the Post Office should devote 1 per cent. of the telephone revenue to advertising and publicity. On this basis a sum of £180,000 a year would be available for commercial advertising. Simultaneously, new construction work should be accelerated and extended in anticipation of the increased demand that would inevitably follow.

Radio Notes.

Czecho-Slovakia.—INTERNATIONAL CONFERENCE.—A conference of the principal European telegraph departments will be held in Prague from April 4th to 13th, following an invitation from Czecho-Slovakia. Apart from matters relating to international radio-telegraphy, the principal subject to be discussed will be the allotment of wavelengths for European broadcasting, says *World-Radio*. The Union Internationale de Radiophonie will be represented at the Conference.

The telegraph administrations of no less than 26 countries will take part in the Conference, as well as eight private societies.—*Reuter* (Prague).

France.—EIFFEL TOWER WAVE-LENGTH.—The Eiffel Tower wireless station, which for six years has been worked on a wave-length of 2,650 metres, is apparently still undergoing readjustment for 1,465 metres. This wave-length has been chosen to obviate the difficulty of the Eiffel Tower swamping Daventry and Radio-Paris, but very delicate adjustment will be required to prevent interference with the Paris airport of Le Bourget, where specially selective apparatus is to be installed.

Jugo-Slavia.—NEW STATION.—The new broadcasting transmitter at Belgrade, a Marconi 9-kW installation, having satisfactorily completed its tests, was officially opened on March 24th. The signals of this station are well received in England; it has been built by Marconi's Wireless Telegraph Co., Ltd., and is, in appearance, similar to the London station, although not quite so powerful. The whole of the transmitting station is in the centre of Belgrade, in the Academy of Sciences, and three studios will be used in the production of the programmes. The aerial is suspended between masts approximately 80 feet high which have been erected on the top of the building, and the transmitter works on a wavelength of 452 metres with an aerial energy of about 2 kW. There are at present within range of this station about 7,000 listeners with valve receivers, but it is anticipated that the introduction of the modern plant will result in the number of receivers in the district increasing rapidly.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—May 15th. Victorian Railways. One geared 3-phase electric winding engine. (A.X. 7650.)*
April 5th. Rectifiers and storage batteries for power signalling. (B.X. 5166.)* Dwarf electric signal mechanisms. (B.X. 5168.)*

Batley.—April 15th. Electricity Department. L.p. cable. (See this issue.)

Belgium.—HASSELT. April 3rd. Provincial Government authorities. Supply and erection of a h.p. electric power transmission line between Bourg-Leopold and Lommel.

Bridport.—April 15th. Electricity Department. H. and l.p. underground and overhead cables. (See this issue.)

Bulgaria.—PLOVDIFF.—May 20th. Provincial Council. Supply and erection of plant for the Vatscha-Kricim hydro-electric power station. Two Francis turbines to operate under a head of 285 ft., two 5,000-kVA generators, two 5,000-kVA transformers, two 1,000-kVA ditto, and two 150-kVA ditto.

China.—SHANGHAI.—March 30th. Kailan Mining Administration. Two 300-kW turbo-generator sets. (B.X. 5174.)*

Dumfries.—April 17th. Electricity Department. One water cooling tower. (See this issue.)

Dundee.—April 10th. Electricity Department. D.c. and a.c. house service meters. 30,000 pairs arc lamp carbons. (See this issue.)

Edlington.—April 17th. West Riding Education Committee. Installation of electric lighting at new schools and caretaker's house. Education Officer, County Hall, Wakefield.

Egypt.—CAIRO.—May 15th. Ministry of Public Works. 120-kW d.c. Diesel engine generating set and a small electrically-driven cooling water pump. Forms of tender from the Chief Inspecting Engineer, 41, Tothill Street, S.W.

Farnworth.—April 3rd. Electricity Department. L.p. cables. (March 22nd.)

Glasgow.—April 2nd. Corporation. Electric light and heating installation for the new police station at Millerston. Specifications, &c., from office of Public Works, 64, Cochrane Street (£2 2s. deposit).

India.—April 5th. South Indian Railway Co., Ltd. Electrical materials and fittings. Specifications from the company's offices, 91, Petty France, Westminster, S.W.

London.—CENTRAL ELECTRICITY BOARD.—April 15th. North-West England and North Wales Electricity Scheme, 1928. 33,000-V overhead transmission lines. (March 1st.)
April 29th. Central Scotland Electricity Scheme, 1927. Electricity meters. (March 15th.)
PADDINGTON.—April 8th. Great Western Railway. Stores, including electrical wires and cables, telegraph ironwork, and iron and steel wires. (March 22nd.)
LONDON COUNTY COUNCIL.—The Highways Committee will shortly invite tenders for 150 modern type tramcars.

Manchester.—April 3rd. Electricity Committee. One 8,000-kVA air-cooled transformer. (March 15th.)
April 8th. Two 33,000-V metal-clad switch units. (March 22nd.)

Middlesbrough.—April 10th. Electricity Department. 12 months' supply of cables and meters. (See this issue.)

New Zealand.—WELLINGTON.—April 15th. Post and Telegraph Department. Conductor cords. (B.X. 5098.)*

South Africa.—UMTALI.—April 18th. Municipal Council. 1,000-kW turbo-alternator, spray cooling plant, switchgear, transformers, crane, &c. (B.X. 5142-5.)*
JOHANNESBURG.—April 25th. South African Railways and Harbours. Three electrically-driven wheel lathes. (A.X. 7621.)*
May 16th. Electric signalling apparatus. (B.X. 5165.)*

Southampton.—April 30th. Electricity Department. Steel-framed building, steelwork for firing floor, platform carrying induced draught fans, overhead bunkers, &c.; two water-tube boilers with superheaters, economisers, air heaters, mountings, chain-grate stokers, water walls, induced and forced draught fans, sootblowers, steel flues and chimneys, grit arrestors and collectors, &c.; steam feed water and other piping, covering, &c.; water softener. (See this issue.)

Stoke-on-Trent.—April 12th. Electricity Department. One 22/24-h.p. heavy oil engine for Stallington Hall. (See this issue.)

Uruguay.—Montevideo.—May 6th. State Electricity Works. Electric cables and accessories. (B.X. 5178.)*

Wolverhampton.—May 10th. West Midlands Joint Electricity Authority. One 50,000-kW turbo-alternator with step-up transformers, &c., condensing plant, boiler feed pumps, evaporators, circulating water pumps, &c., main and auxiliary, 33,000-V switchgear with circuit breaker. (See this issue.)
April 5th. Three single-phase, 4,000-kVA transformers. (March 22nd.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Aberdeen.—
Electrical work in connection with the erection of 392 houses at School Road, Aberdeen.—Andrew M'Robb.

Australia.—Melbourne.—State Electricity Commission. Accepted :—
Two 37,500-kV Brown-Boveri transformers for the Richmond terminal sub-station (£19,356).—Gibson Battle (Melb.) Pty., Ltd.
—*Tenders.*

Bedford.—Electricity Committee. Recommended :—
Supply of cable for 12 months.—Siemens Bros. & Co., Ltd.

Croydon.—Electricity Committee. Recommended :—
E.h.p. switchgear (£1,266).—A. Reyrolle & Co.

Glasgow.—Electricity Committee. Recommended :—
Ten a.c. motors (£545).—English Electric Co., Ltd.
Accepted :—Replacement of plant in connection with the change of frequency under the Central Scotland Scheme (Bilsland Bros.). Replacement of 25-cycle plant by 50-cycle plant (£219).—English Electric Co., Ltd.
Switchgear for Langside sub-station (£143).—A. Reyrolle and Co., Ltd.
Tramways Committee. Recommended :—
Trolley wire.—Thomas Bolton & Son, Ltd.
Portable vacuum cleaning plants.—Barr & Co.; Metro-Vick Supplies, Ltd.

Government Contracts.—The following Government contracts were placed during February, 1929 :—

Admiralty, Contract and Purchase Department.
Generator boards, &c.—Whipp & Bourne, Ltd.
Brackets, pendants, &c.—Bonnella Bros., Ltd.; Hawkers, Ltd.; W. McGeoch & Co., Ltd.; Player & Mitchell; Gabriel & Co., Ltd.; Revo Electric Co., Ltd.; Veritys, Ltd.
Branch breakers, &c.—Whipp & Bourne, Ltd.
Bridge meggers and resistances.—Evershed & Vignoles, Ltd.
Electric cable.—Anchor Cable Co., Ltd.; British Insulated Cables, Ltd.; Connollys (Blackley), Ltd.; Edison Swan Cables, Ltd.; Enfield Cable Works, Ltd.; General Electric Co., Ltd.; Glover & Co., Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; India Rubber, Gutta Percha and Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; St. Helens Cable and Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.; Liverpool Electric Cable Co., Ltd.
Air compressor.—Reavell & Co., Ltd.
Electric gantry.—Stothert & Pitt, Ltd.
Overhead electric cranes.—Vaughan Crane Co., Ltd.
Electrical installation.—Johnson & Phillips, Ltd.
Engine equipments.—Parsons Oil Engine Co., Ltd.
Ship ventilating fans.—Electro-Dynamic Construction Co., Ltd.; Veritys, Ltd.
Incandescent electric lamps.—General Electric Co., Ltd.; Edison Swan Electric Co., Ltd.
Mica.—Micanite and Insulators, Ltd.; Mica and Micanite Supplies, Ltd.; Dacier, Ltd.
Micanite.—Mica Products, Ltd.; Mica Manufacturing Co., Ltd.
Motor booster set.—Electric Construction Co., Ltd.
Motor convertor set.—English Electric Co., Ltd.
Motor generator sets.—Rotax (Motor Accessories), Ltd.; Veritys, Ltd.
Switches.—A. Reyrolle & Co., Ltd.; W. McGeoch & Co.; Bertram Thomas.
Electric overhead travellers.—J. Adamson & Co.; Cowans, Sheldon & Co., Ltd.

War Office.
Generators.—G. Kent, Ltd.

Air Ministry.
Cable.—Hackbridge Cable Co., Ltd.
Electric motors.—Bull Motors, Ltd.
Valves.—Edison Swan Electric Co., Ltd.

Post Office.
Telegraph apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Creed & Co., Ltd.
Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; Ericsson Telephones, Ltd.; Siemens Bros. & Co., Ltd.; Sterling Telephone and Electric Co., Ltd.; Telephone Manufacturing Co., Ltd.
Testing and protective apparatus.—Automatic Telephone Manufacturing Co., Ltd.; International Electric Co., Ltd.; Phœnix Telephone and Electric Works, Ltd.
Battery stores.—D.P. Battery Co., Ltd.; Ever-Ready Co. (Gt. Britain), Ltd.; Fuller Accumulator Co. (1926), Ltd.; General Electric Co., Ltd.; Pritchett & Gold and E.P.S. Co., Ltd.; Siemens Bros. & Co., Ltd.
Cable bearers.—Bullers, Ltd.
Terminal blocks.—T. De la Rue & Co., Ltd.
Battery boxes.—Ericsson Telephones, Ltd.
Cable.—British Insulated Cables, Ltd.; W. T. Glover and Co., Ltd.; Siemens Bros. & Co., Ltd.
Joint box castings.—General Foundry and Engineering Co., Ltd.; United Steel Companies, Ltd. (T. Butlin & Co.).
Loading coils.—Siemens Bros. & Co., Ltd.
Cords for telephones.—L.P.S. Electrical Co., Ltd.; Reliance Electrical Wire Co.
Electric lamps.—Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.
Manufacture, supply, drawing-in and jointing cable.—Manchester-Huddersfield : Pirelli-General Cable Works, Ltd. Manchester-Liverpool (No. 5) : Standard Telephones & Cables, Ltd.
Telephone Exchange equipment.—Stockport, Park, Western : Siemens Bros. & Co., Ltd. Grosvenor (S.W.) : Automatic Telephone Manufacturing Co., Ltd. Aldridge (Walsall Multi-Exchange Area) : Ericsson Telephones, Ltd. Sub-contractors : W. Jones & Co., for ringing machines. Birmingham (Midland), Birmingham (Northern), Birmingham (Victoria), Birmingham (Harborne) : General Electric Co., Ltd. Sub-contractors : Crompton Parkinson, Ltd., for ringing machines and charging machines. D.P. Battery Co., Ltd., for batteries. Kent Education Committee (Maidstone) : Relay Automatic Telephone Co., Ltd.

Crown Agents for the Colonies.
Battery materials.—India Rubber, Gutta Percha and Telegraph Works Co., Ltd.
Electric lamps.—General Electric Co., Ltd.
Insulated fittings.—W. T. Glover & Co., Ltd.
Lightning arrestors.—Siemens Bros. & Co., Ltd.
Sounder sets.—Automatic Telephone Manufacturing Co., Ltd.
Static transformer.—Brush Electrical Engineering Co., Ltd.
Sub-station material.—English Electric Co., Ltd.
Surface condensing plant.—Belliss & Morcom, Ltd.
Telegraph poles.—Bullers, Ltd.
Telephones.—Ericsson Telephones, Ltd.
Train lighting spares.—J. Stone & Co., Ltd.
Turbine feed pump.—G. & J. Weir, Ltd.
Wire.—Whitecross Co., Ltd.

Hornsey.—Electricity Committee. Recommended :—
Troughs and bridges for 12 months.—Doulton & Co., Ltd.
Cables for 12 months.—Standard Telephones and Cables, Ltd., and Pirelli-General Cable Works, Ltd.

Irish Free State.—Dublin.—Department of Local Government and Public Health.
Six months' supply of electric lamps.—Siemens Electric Lamps and Supplies, Ltd.

Leicester.—Sewage Committee. Recommended :—
Three electrically-driven pumps for Belgrave pumping station (£4,097).—Hayward, Tylor & Co., Ltd.

London.—Central Electricity Board.—The Board has placed the following contracts :—
South-East England Scheme—
66-kV and other transformers in the London Area.—Hackbridge Electric Construction Co., Ltd.; British Electric Transformer Co., Ltd.
Central England Scheme—
132-kV transformers.—British Thomson-Houston Co., Ltd.; British Electric Transformer Co., Ltd.
North-West England Scheme—
132-kV transformers.—British Electric Transformer Co., Ltd.; British Thomson-Houston Co., Ltd.; Ferranti, Ltd.
132-kV outdoor switchgear.—Ferguson, Pailin, Ltd.; Metropolitan-Vickers Electrical Co., Ltd.
The value of the contracts is approximately £1,500,000.
London County Council.—Education Committee. (Recommended.)
Electric lighting installation for the Bentworth Road School, Hammersmith.—Alpha Manufacturing and Electrical Co., Ltd. (£268).
Wandsworth.—Libraries Committee. Accepted :—
Electric lighting for open access system at libraries : Allfarthing Lane Library (£84), L. J. Godfrey; Putney Library (£135) and Streatham Library (£225), Alpha Manufacturing & Electrical Co., Ltd.

Macclesfield.—Board of Guardians. Accepted :—
Installing electric light and bells at the casual wards.—Mr. V. Brees.

Portsmouth.—Parks Committee. Accepted :—
Electric light installation at Cemetery Lodge, Milton.—W. J. Lenton.
Electricity Committee. Accepted :—
4,000 yd. of .12 sq. in. twin l.p. cable.—Johnson & Phillips, Ltd. (£1,480). (Accepted.)

Preston.—Electricity Committee.
Supply and erection of 6,600-volt switchgear to control two Preston-Blackpool transmission lines (£5,325).—Metropolitan-Vickers Electrical Co., Ltd. (Recommended.)

South Africa.—CAPE TOWN.—Electricity Committee. Recommended :—
Switchgear in connection with supply to Tiger Oats Co., Ltd. (£1,028).—A. Reyrolle & Co., Ltd.
Twenty-four 1,000-A quick-break knife switches (£310).—Switchgear & Cowans, Ltd.
Motor and starting equipment for the Walmer Brickworks (£285).—S.A. General Electric Co., Ltd.

Southend-on-Sea.—Town Council. Accepted :—
Three double-deck trackless vehicles (£5,908).—Richard Garrett & Sons, Ltd.
Two miles of overhead trolley wire (1s. 1d. per lb.).—Union Cable Co., Ltd.

Spenborough.—Urban Council. Accepted :—
Installing electric light at Council houses.—40 houses (£303), Butler & Horn; 96 houses (£707), Hepworth and England.

Stoke-on-Trent.—Electricity Committee. Accepted :—
Ironclad switchgear (£2,046).—A. Reyrolle & Co., Ltd.

Forthcoming Events.

Institution of Electrical Engineers (Meter and Instrument Section).—Friday, April 5th. Institution, London, W.C. 7 p.m. "Some Technical Considerations concerning Power Factor in Relation to Tariffs." Mr. E. W. Hill.

(London Students' Section).—Tuesday, April 2nd. 2.30 p.m. Visit to the North Metropolitan Electric Power Co.'s supply station, Brimsdown.

(North-Eastern Centre, Students' Section).—Friday, April 5th. Dial House, Northumberland Street, Newcastle-on-Tyne. 7.15 p.m. Annual general meeting.

Television Society.—Tuesday, April 9th. Engineers' Club, Coventry Street, London. W.1. 8 p.m. "Some Notes on Exploring." Mr. J. Cameron Rennie.

Notes.

Improvements in Electricity Meters.

In a recent issue of the *E.T.Z.*, Herr Schachenmeier deals at considerable length with the improvements that have taken place in recent years in the design and construction of electricity meters in Germany. Particularly as regards single-phase meters, marked progress has been made in the reduction of both their size and weight. By using sheet-metal in place of castings, meters of great strength and solidity are now being turned out, while by a better utilisation of the magnetic flux the method of working has been improved and the consumption of current reduced. Various improved methods have been introduced to counterbalance the effects of varying temperatures, some utilising a bi-metallic blade which acts either on a piece of iron which varies the flux across the disk, or directly on the disk itself, while in other cases auxiliary windings with special temperature co-efficients are employed.

Electro-farming in America.

The Governor of Virginia, Mr. Harry F. Byrd, after bringing together representatives of farm organisations, power companies, and State agencies, announced plans for a State-wide farm electrification programme. The principles which have been so successful in this project in Pennsylvania will be carried out, and a special advisory commission has been named, including representatives of farm, power, and State interests, to fix rates, recommend types of machinery, and otherwise obtain the best and cheapest electrical service for the farms.

"Election Houses."

Our local correspondent reports that Alderman H. Kegie, of Gateshead, the prospective Labour candidate, when opening his campaign in the Berwick Division on Saturday, said that if returned to power the Labour Party would cheapen electricity so that the people could have all-electric houses like his own, for which the cost of electricity was 1d. per kWh.

E.P.E.A. Dinner.

The London Local Technical Group of the Electrical Power Engineers' Association held its first social function on March 16th at the New Princes Galleries, Piccadilly. Some 154 members and friends were received by the chairman of the group (Mr. W. J. Jeffery) and Mrs. Jeffery. Dinner was served at separate tables, an arrangement which proved to be very successful, and the function was unique in that there were no speeches; consequently the company had extra time for dancing, which was indulged in until midnight, and members had the pleasure of a private view of the exhibition of water-colour paintings and the miniature portraits with which the walls of the galleries were adorned.

The Batti-Wallahs' Society.

At the annual general meeting the following officers and committee were elected for 1929—President, Mr. H. L. Howard; Vice-President, Mr. H. J. S. Mackay; hon. secretary and treasurer, Mr. M. Whitgift; Committee: Messrs. A. E. Apps, G. M. B. Hilton, H. S. Jacob, W. E. Lang, H. S. May and A. E. Mohring. The following gentlemen have recently been elected Batti-Wallahs; Messrs. E. A. Gatehouse. H. D. Harris. J. W. Porter, E. Stuart Russell, A. A. Campbell Swinton, F.R.S., and Lt.-Col. W. A. Vignoles, D.S.O. The entrance fee for new members has been increased to two guineas.

For the luncheon on April 25th, at which Sir Hugo Hirst, Bt., will deliver an address, tickets (5s. 6d. each) may now be obtained. The large hall at the Hotel Cecil has been engaged, but early application is desirable. The occasion will be used to give a general welcome to Sir Hugo upon his return from Australia.

Therapeutic Light Treatment.

The conclusions of the Medical Research Council on the value of ultra-violet ray treatment, which amounted to a declaration that there was no evidence that it exercised any beneficial effect that could not be obtained by more familiar methods at far less cost (see p. 528, March 22nd issue) has aroused indignation among the manufacturers of apparatus. It is reported that at a meeting held at the London offices of the British Electrical and Allied Manufacturers' Association protests were made against the summary treatment by the report, both of the industry and of the large number of medical practitioners throughout the country who use light-therapy. It was declared that the report simply condemned an industry on the basis of two experiments: one was carried out in 1925 and the other in 1927-28. In neither case was the evidence sufficient or scientifically presented it is claimed.

An Electrically-operated Razor.

An electrically-operated bladeless razor has been invented by a New York firm. It is based on a combination of shearing and nipping by rapid vibration of the inner of two parallel slotted shearing plates. The apparatus, which is only slightly larger than an ordinary safety razor, can be attached to an ordinary lighting socket, no lather is required, and a shave of any desired closeness can be obtained. There being no sharp edges and no moving parts in contact with the skin, cuts and abrasions are impossible.—*Reuter's Trade Service* (New York).

Wages in the Cable-making Industry.

The Joint Industrial Council for the Electrical Cable-Making Industry announces that there will be no cost-of-living variation in wages on the third pay day in April.

Appointments Vacant.

Mains engineer for the Aylesbury Corporation Electricity Department; two second charge engineers for the U.D.C. of Newry Electricity Department; power station superintendent for Stoke-on-Trent Corporation Electricity Department; charge engineer for the Borough of Doncaster Electricity Department; junior technical assistant (£350) for the Air Ministry. (See our advertisement pages to-day.)

Metal Trades Benevolent Society.

The third annual golf competition for the President's Cup, organised by the Royal Metal Trades Pension and Benevolent Society, is to be held at Sundridge Park on May 29th. Particulars can be obtained from the Secretary, 195, Upper Thames Street, E.C.4.

Works Visit.

On Tuesday this week members of the South Midland Students' Section of the Institution of Electrical Engineers paid a visit to the works of the Midland Electric Manufacturing Co., Ltd., Birmingham.

Public Address Relays.

A political address in the Albert Hall on March 26th was carried to no less than thirteen other towns over an aggregate of more than one thousand miles of special Post Office trunk-lines. This is the latest development in the new system of speech relays and has necessitated the design of special Marconiphones capable of distributing the amplified words evenly over such a considerable area. Great care is necessary to prevent interruption and cross talk, each line being isolated from all exchanges en route, while repeater valve amplifiers at various points ensure adequate volume and clarity. The audiences were as far apart as Southampton, Ramsgate, Norwich, Nottingham and Coventry, and a circle drawn through these outermost towns of the system would embrace no less than twenty thousand square miles.

Constant-frequency Gramophone Records.

The Gramophone Company's electrical experimental department at Hayes has made constant-frequency records specially cut and calibrated so as to produce a series of pure tones ranging over about 8½ octaves on the musical scale. The set consists of 15 double-sided 12-inch records giving 100 different frequencies of 50 seconds' duration each. The waves are sinusoidal in form and, provided that the turntable runs exactly at 78 revolutions per minute, the frequencies are correct to within 1 per cent. of those stated upon the labels, so that they form an excellent source of alternating oscillations over a wide range; the frequencies range from 25.5 to 8,460 cycles. The double amplitudes in inches and the maximum velocities of needle point in a direction perpendicular to the normal line of groove in inches per second have been calibrated, and are printed upon the labels. The records have been cut so as to produce a substantially constant output of a.c. energy at from 250 cycles upwards, whilst below 250 cycles there is a gradual decrease of energy. The exact amount of energy has been calibrated, and is given on the labels in the form of transmission units above, or below, the energy of the 993-cycle note, the transmission unit, or T.U., being a well-known standard of measurement in telephony practice. The records should be useful for experimental laboratories, colleges, and music schools, as well as for gramophone dealers. If used on an ordinary acoustic gramophone they give an accurate response of the output of the machine, and are particularly useful for rapidly and accurately comparing the relative merits of various sound boxes, horns, and machines. If used with an electrical pick-up and valve amplifier they give electrical alternating currents of good wave form and known frequency, and the generated power may easily be measured, so that various pick-ups, amplifiers, loud-speakers, or other telephone and wireless apparatus may be calibrated under normal conditions. For ordinary laboratory and experimental tests the records form a good substitute for an expensive electrical oscillation generator, and will form a reliable means of checking the constancy of speed of gramophone motors and any rapidly rotating apparatus.

Radio Interference.

The Department of Scientific and Industrial Research has issued Radio Research Special Report No. 8 (H.M. Stationery Office, 1s. net) which describes an investigation commenced in 1923 under the direction of the Radio Research Board in response to a request from the Sub-Committee on Technical Wireless Regulations of the Imperial Communications Committee. The Sub-Committee, being engaged in drafting national wireless regulations which might form the basis of proposals for the 1927 meeting of the International Radio Telegraph Convention, asked the Board to consider the utility of certain figures for "equivalent decrement" as a basis for the classification of transmitting stations in respect of their interfering properties, "equivalent decrement" being a quantity defined in Section LXXXII of the Regulations of the Washington Draft Convention of 1920. From experimental measurements at the National Physical Laboratory during 1923-24 it was concluded that "equivalent decrement" was not an adequate criterion of interference in radio communication; experiments made by the Post Office Engineering Department also confirmed this conclusion. During 1926-28 a considerable amount of theoretical and experimental work was carried out at the National Physical Laboratory, but failed to produce a practical and easily applied method of measuring interference. In the meantime, owing to various improvements in the technique of radio communication, the necessity for immediate legislation on the subject had decreased; furthermore, largely as the result of the work carried out in this country and described in the present Report, the International Radio Telegraph Convention held at Washington in 1927 abandoned the use of the quantity "equivalent decrement" and made no alternative suggestion for defining interference. It was decided, therefore, to discontinue this rather unpromising line of research. In view, however, of the probable importance of the problem of interference in connection with the future regulation of radio communication, it was considered desirable to draw up the present Report as a record of the progress made and a statement of the difficulties to be overcome. The distinctive feature of the mutual interference of wireless transmissions and the difficulties which at present lie in the way of its effective control by international regulation is that the source of interference is not the periodic and quasi-stationary element of the transmission, but the non-periodic and transient elements. Periodic phenomena are fairly well understood and a practical technique is ready to hand for their quantitative specification; this is the well mapped field of Fourier's theorem. Interference problems, on the other hand, take one into the relatively unexplored field of Fourier's integral; both theory and technique are comparatively undeveloped, probably because of the less obvious practical significance of those branches of mathematics and electricity, and because of the greater complexity of the theory and the much greater difficulty of the technique involved.

The Oil and Colour Exhibition.

At the second International Oil, Chemical and Colour Trades Exhibition, which was held at the Royal Agricultural Hall, Islington, last week, a few items of electrical interest were to be seen. The advantages of electric driving for the machines used in the trades concerned were apparent, and, as in the more widely-known industries, the built-in-motor feature seemed to have become standardised. It was encouraging to hear manufacturers who cater for all classes of driving say that it paid them now to adopt electric driving as the standard. Two items of particular interest were seen on the stand of Messrs. Thomas Broadbent & Sons, Ltd. One was a 42-in. "Weston" centrifugal machine, embodying novel methods of housing the motor and driving. The motor is a 10-h.p. specially-designed, totally-enclosed vertical machine, housed, of course, on top of the centrifuge without being held rigidly to the frame. Torque-reaction gear in the form of heavy leather belting prevents the stator from revolving. The actual weight of the motor is taken by a conical buffer at the top end of the machine shaft. This method of housing has enabled vibration effects to be neglected, resulting in an acceleration to full load in 80 sec. Complete deceleration to rest is effected in 45 sec. The motor is switched directly on to the line, and has a starting current ten times the running current. The other machine referred to is an electrically-driven hydro-extractor. This employs a specially-designed high-starting-torque motor, directly-coupled and housed under the machine. This motor is also designed for direct switching, and it will, it is claimed, submit to from eight to ten starts per hour without overheating. Paint-mixing machines were featured at the show, and an interesting one was that displayed by Messrs. Joseph Foster and Sons, Ltd., being a four-unit battery, each unit having a capacity of 10 gal. Oil-enclosed gears for the actual mixers are carried overhead and are driven longitudinally through a common shaft by about a 10-h.p. motor. Messrs. Lacy-Hulbert and Co., Ltd., showed an interesting range of electrically-driven air compressors for paint spraying, and so on. The "Boreas Electric Air Blast" shown by this firm is a very neat little machine which should prove useful to the motor-maintenance man for blowing-out operations. A small rotary compressor and the 1-h.p. driving motor are arranged in unit form, complete with the necessary switchgear, hose, and so on. The gross weight of a machine for a.c. supply is 150 lb. Romac Motor Accessories, Ltd., also showed some interesting portable electrically-driven air compressors. A four-cylinder "Romac" compressor driven by a ½-h.p. motor is specially designed for paint spraying. Another "Romac" machine has twin compressors and is equipped with a 1-h.p. motor. Tungstone Accumulator Co., Ltd., showed a 26-cell, 52-V, 7-plate battery with a capacity of 108 Ah. Messrs. L. G. Hawkins & Co., Ltd., featured the "Sprayit Electrically" paint-spraying machines. Alfa-Laval Co., Ltd., showed some interesting electrically-driven clarifiers. A 1-ton per hour De Laval machine is fitted with a separate motor driving through an infinitely variable speed gear.

Electrical Association for Women.

The annual meeting of the South Wales and Monmouthshire branch of the Electrical Association for Women was held at Cardiff on March 19th. Outlining the activities of the branch, Mrs. E. A. Clement said the membership had reached 200.

On March 18th members of the Manchester and Salford District branch paid a visit to the Hyde Road Depôt of the Manchester Corporation Tramway Department.

On March 7th the Birmingham and Midlands branch held a ball at the Grand Hotel, Birmingham, which was a huge success. A party of members of the same branch paid a visit to the Municipal Wash-house, Birmingham, on February 29th, where they saw a large family wash done electrically, including iron and airing, in two hours at a cost of 1s. 3d. On February 21st Mr. J. L. H. Cooper, of the Electric Lamp Manufacturers' Association, gave an enlightening lecture on "Lighting in the Home" to the members of the Birmingham branch. Demonstrations were given in colour lighting.

On March 22nd Mr. R. A. Parsons, A.M.I.E.E., gave a practical demonstration on "Bells and Batteries" before an appreciative audience of the Mid-Gloucestershire branch of the Association.

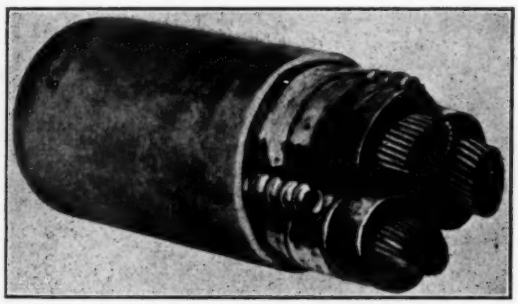
The last of the E.A.W. evening lectures for the current session was given on March 19th, when Mr. H. Bourne, of the Hendon Electric Supply Co., spoke on "Some Electrical Facts Concerning Electric Motors." The chair was taken by Miss Dorothy Vaughan, and a vote of thanks was proposed by Miss de Buriatte. By arrangement with the Association, Mrs. Hammer gave a lecture before the National Council of Women at Berkhamsted on March 19th, as a result of which members of the N.C.W. at this Centre will pay a visit to the electrical showrooms at Hackney in the near future.

Protein Synthesis.

Dr. Newton Harvey, Princeton Professor of Physiology, addressing the American Institute of Science, New York, predicted that "living light" will be synthesised (*i.e.*, reproduced artificially) in future. After explaining the process by which the firefly provides illumination, he discussed its practical application for future developments. Dr. Harvey, who has made a study of animals endowed with luminescence, said he had found forty groups of the animal kingdom and two groups of plants to be luminous.

A New Oil-filled Cable.

Some interesting particulars are given in an article in a recent issue of the *Electrical World*, by Messrs. G. B. Shanklin and V. A. Sheals, of a new cable of the oil-filled type which has been developed by the General Electric Co. of America and installed in Chicago for operation at 33-kV. The following are the main points of departure from the original oil-filled cable plan. The reels of cable are shipped and installed under oil pressure without draining the oil from the channels; this is made possible by supplying each reel length with a relatively small pressure reservoir. Instead of having the channels in the form of a hollow core inside the conductor, they are placed in the filler spaces, as shown in the accompanying illustration; these channels are consequently at ground potential instead of full-line potential, allowing easy entrance at any point desired for purposes of oil feed, segregation, withdrawal of oil samples, &c. In the case of single-conductor cable the same results are accomplished by placing the channels directly under the lead sheath. With the hollow-core type of cable the points of entrance can be made only by the insertion of "stop joints" of rather complicated design. A type of "semi-stop joint" which is very simple in design and construction is used for connecting the reel lengths of cable in place of the regular joints used in ordinary installations. The purpose of the cork seal or plug placed at each end is twofold: first, during installation it allows work on the joint proper to be done while oil



Three-core Oil-filled 33-kV Cable.

pressure is maintained on the cable, preventing drainage of insulation and entrance of air; secondly, for all practical purposes it segregates each length of cable from adjacent lengths, so that in case one length bursts open in operation, oil is drained only from the defective length without involving other lengths. Each segregated cable length has its own individual reservoir feed. A considerable saving is made by eliminating the reinforced double-lead sheath and using instead a single sheath of the ordinary kind, except that it is made of lead-alloy to obtain greater mechanical strength. As far as can be determined, an alloy sheath should safely withstand a maximum operating oil pressure of at least 15 lb. per square inch. The present installation in Chicago is now adjusted for a maximum pressure of 12 lb. In the cable the three conductors are made up in semi-sector shape, the central part being preformed to a sector shape, around which are stranded 54 wires in three layers, making a total cross-section of 350,000 circ. mils. Each conductor is insulated with 0.280 in. of wood-pulp paper and covered with a 0.75-in. by 0.0005-in. perforated copper tape, put on with an opening between turns not exceeding 0.094 in. The usual centre and side fillers are omitted, and in place of the side fillers copper tubes, 0.4 in. in outside diameter, made up in the form of General Electric BX type conduit, are substituted. These fillers are so made that the oil can flow freely in a lateral direction in or out of them. Thus all the free space between the sheath and conductors is available for oil channels. Over the three conductors and copper fillers is a 1.0-in. by 0.004-in. steel tape put on with a 0.625-in. opening. The lead sheath is applied directly over the steel tape. The sheath is 0.156 in. in thickness and is made of lead alloyed with 2 per cent. tin to give mechanical strength against internal pressure. The cable section which crosses under the Sanitary District Canal, Chicago, is armoured with 48 galvanised-steel wires 0.134 in. in diameter. The lead sheath is first coated with asphalt, then a layer of rubber-filled tape and a second coat of asphalt. The armour wires are put on with a short pitch (approximately 45 deg.) in order to give mechanical support to the lead against the high internal pressures to which it would be subjected in the event of the water in the tunnel shaft being pumped out.

A Big Electric Welding Job.

A pipe-line, 205 miles long, which will carry natural gas from Jal, New Mexico, to El Paso, Texas, in the United States, is now being electrically welded. The pipe is 16 inches in diameter and 27 sets of welding equipment are being used, some mounted on tractors and driven by the tractor engine, and the other mounted on trucks and trailers. The pipe is in 30-foot sections, seven of which are lined up together for welding. One welding crew fixes each section temporarily in position by tack welding, and another completes the job. The tack-welding machines are self-propelled, as the first welding crew is often some distance ahead of the men who complete the operation. The pipe is turned, as the welding progresses, by one man using long-handled tongs. Every seventh joint is an expansion joint, which consists of a short piece of pipe with upset corrugations, adding flexibility to the pipe and also allowing for expansion and contraction when in use. After the 200-foot sections are completed, another crew lines them up with the completed pipe line, using a caterpillar tractor and boom. As the pipe cannot then be turned, the welds are made by the "bell-hole" method, in which the operator moves his own position to weld all sides of the pipe, making the weld on the lower side from an excavation dug beneath for that purpose. By the use of 3/16-in. diameter welding electrodes and a current of approximately 175 to 190 amperes, the greatest welding speed consistent with the highest-quality weld can be obtained. Each operator is able to make approximately 13 welds in ten hours. After the final welding operation is completed, the joints are tested and then treated with a corrosion-resisting compound, after which the pipe is lowered into the channel that has been dug for it.

Fatality.

An inquest was held recently at Gateshead on the body of Wilfred Hughes (16), apprentice moulder, who received a fatal electric shock at Messrs. Clarke, Chapman & Co.'s Victoria Works. Leonard Colman, metal moulder, stated that deceased and he were at work on a gantry above the foundry floor level. Above them was a number of electric travelling cranes, the wiring for which was about 10 ft. above the floor level and was shielded only by asbestos-covered boards, some of which were damaged owing to molten metal having splashed on them. Witness asked the boy to get a "shank," a piece of metal some 10 ft. long, which was standing in a corner beneath an electric crane. The boy hurried away and the next thing witness heard was a shout from one of the workmen. He looked up to see the boy standing rigidly beneath the crane, with the shank gripped to his breast. The crane driver was told to switch off the current, whereupon Hughes collapsed. He was afterwards conveyed to the ambulance station. Arthur Ford, a metal moulder, stated that he thought one end of the shank had touched a "live" wire. The jury returned a formal verdict and urged that more adequate protection be given to the wires.

Manchester Steam Users' Association.

The annual report of the Association, which aims at the prevention of boiler explosions and the attainment of economy in the application of steam, shows that in 1928 the surplus of revenue over expenditure was £1,788, which, being added to the reserve fund, brings the latter to £51,973. The total number of examinations made during the year was 24,501, and no preventable explosion has occurred of any boiler which has been covered by the Association's guarantee and certificate of safety. Since the publication of its last report, the Association has recorded the occurrence, outside its ranks, of 69 explosions in the United Kingdom, which resulted in the killing of thirteen persons and injury to forty-eight others. During the same period reports were received of 61 preliminary inquiries held by the Board of Trade under the Boiler Explosions Acts, 1882 and 1890. There were also eight formal investigations held under the same Acts at which costs amounting to £378 were ordered to be paid by the parties found to be in default. The Association's annual memorandum, which has been issued for the year 1928, contains a consecutive review with illustrations of the various experiments carried out by the Association from time to time to determine weaknesses in boiler construction and material. Hitherto the information thus obtained has been disseminated through separate publications covering a considerable period; the present publication therefore should prove useful as well as interesting.

Company Fined for "Smuggling" Electricity.

An unusual case has just concluded in the Belfort Courts in which the Customs authorities sued an electricity company for 80,000,000 francs (£640,000) for alleged non-payment of import duty on electrical energy obtained from Switzerland. The company resisted the claim, asserting that electrical energy, being imponderable, could not be taxed. The Court decided in favour of the Customs and ordered the unfortunate company to pay to the authorities 40,000,000 fr. (£320,000) as Customs duty, and an additional 40,000,000 fr. as a fine, as well as smaller amounts for costs.—*Reuter* (Belfort).

Scholarships in Science.

The Board of Education will offer in 1930 20 Royal scholarships and 11 free studentships tenable at the Imperial College of Science and Technology, London. These awards are open

to British subjects of either sex, and there is at present no age limit. The awards will be made on the results of the science scholarships examination which will be held by the Board at various centres, beginning on April 30th, 1930. Applications for entry to the examination must be made on the prescribed form (obtainable from the Board) not later than January 15th, 1930. Candidates may compete in any of the following groups, but in one only:—Engineering, physics, chemistry, biology, and geology. The following scholarships and prizes on the foundation of Sir Joseph Whitworth are offered for competition in 1930 to candidates possessing handicraft experience obtained in a mechanical engineering workshop:—(*a*) two Whitworth senior scholarships of an annual value of £250 tenable for two years; (*b*) six Whitworth scholarships of an annual value of £125, which may be increased in special cases, tenable for three years; (*c*) Whitworth prizes not exceeding 25 in number of the value of £10 to unsuccessful competitors for Whitworth scholarships whose work appears to deserve recognition. The awards will be made on the results of an examination held by the Board in May, 1930. Full details of these scholarships are published in the "Regulations for Whitworth Scholarships, 1928," which may be obtained, price 2d. (by post 2½d.), from H.M. Stationery Office.

New London Tramcar.

The improved electric tramcar of Metropolitan Electric Tramways, Ltd., which was illustrated last week (see p. 505) possesses interesting features. It was built and designed by the Union Construction Co., of Feltham, in conjunction with the engineers of the Underground Railway group, in co-operation with the tramway officials. The car is of *still* lower build, has four motors, special magnetic braking on the rail, and a mechanical attachment to the Ferodo brake shoes on drums (not on the wheels). It is chiefly of all-steel lattice construction and the company is to be congratulated on producing a car 41 ft. by 7 ft. 3 in. double deck, top-covered, vestibule front, to weigh only 16¼ tons with 4-motor control. The height is 14 ft. 10 in., against 15 ft. 6 in., and greater width allows two cross-seats of ample comfort; the extra 4 ft. in length allows roomy staircases. The car has been submitted for approval to the Ministry of Transport and the police. The large platform follows the Continental practice of providing ample space for the short-distance riders; the total seating capacity is 64. The body is carried on a light-weight underframe of steel with pressed-steel solebars and steel body bolsters. The framework of the upper and lower saloons is in one unit, having duralumin gussets, which are employed to reduce noise due to drumming of the body. The exterior panels, including the roof sheets, are of aluminium. There is only one step between the ground and the body floor, representing a total rise of 2 ft. 3½ in., which is six inches lower than the existing standard type of car. The two end lobbies have each an area of 36 sq. ft. The controllers are of a special design adapted to the control of four Metro-Vick 300-volt, 35-h.p., motors and designed to be conveniently operated by the motorman, who sits on a stool. With a view to reducing noise, the brake shoes are lined with Ferodo and have been arranged to operate on a specially designed brake drum, one being fitted to each axle. Braking is effected by magnetic track brakes (operated by the controller) which also apply Ferodo blocks, which are specially protected from the wet, to the brake drums. The drum brake can be operated, if required, by hand independently of the magnetic track brakes, by "Peacock" staffless mechanism. The trucks are of a low-bogie type, the driving wheels being 24 in. in diameter instead of the usual 31¾ in. All axle boxes are equipped with roller bearings. The wheels centres are of cast semi-steel, which has been employed in order to reduce to a minimum the conductivity of noise. The truck frame is carried on the axle boxes by laminated springs. Special attention has been given to the lighting; 40-watt traction lamps at 110 volts are arranged in series of 5; the maximum number of lamps that will be in use at one time when the car is in service is 50. The lamps in the saloons are semi-concealed in the ceilings and a dipping headlight is fitted on each end at the dash, operated by the motorman, so that the beam can be projected on to the track during fog. Each exit step is illuminated by one lamp which automatically comes into operation when the exit door is open. Two trolley poles obviate the necessity for swinging the boom round at the end of each journey; the car is fitted with L.C.C. standard plough gear.

Fires in Coal Heaps.

Some interesting comments on the causes of fires in coal storage heaps were made by Mr. A. J. Hoskin, Purdue University, at the Indiana Fuel Conference last year, according to *Power*. The universally-accepted theory of spontaneous combustion of stored coal is that the coal is heated by its own oxidation. It has been proved that the quantity of heat generated is proportional to the quantity of oxygen involved, regardless of the rate of the reaction. Any fresh bituminous coal exudes a natural gas which is combustible and hence has heat value. This marsh gas is that which causes disastrous explosions in coal mines. Unmined coal is somewhat saturated with this methane, whereas old or weathered coal is practically free from it. The rate of emission is at its maximum when the coal is freshly broken from the seam, and it is higher for the finer grades than for the coarser. This gas, which is part of the so-called volatile combustible in coal, oxidises readily and with the production of heat. Fresh coal heats spontaneously more rapidly than does old coal, and this is attributable to the more rapid emission of this gas by the fresh coal. A mass of coal seldom fires if it survives the early period of storage during which it liberates most of its highly-volatile component. Some operators believe that proper ventilation prevents abnormal heating, while others condemn ventilation as the most potent factor in such heating. Practices in storage based upon these opinions have netted unsatisfactory results. The full-ventilation notion is practically rejected, not because of theoretical error, but because certain limitations in every method that has been tried appear to induce rather than prevent dangerous heating. A medium condition that may be termed restricted ventilation prevails in usual practice. Many kinds of extraneous material find their way into coal during its mining and shipment, or in storage. With the exception of metal scraps these foreign materials have lower ignition temperatures than the coal itself, and therefore ought to be considered as potential kindling. Utmost precaution is required to see that storage coal does not contain bits of wood, paper, blasting fuse, rags, discarded clothing, waste (either dry or oily), charcoal, hay, straw, horse manure, weeds, leaves or twigs from trees, as well as remnants of coal from a former shipment or storage. Each of these types of kindling has been held responsible for coal-heap fires.

The B.E.A.M.A. and Exhibitions.

In the report of the Council of the B.E.A.M.A., issued at the moment of going to press, reference is made to the questions "of exhibitions and exhibition policy." We shall deal with the full report in our next issue, but we extract below the Exhibition paragraphs:—

"During the year an important change was made in procedure under your Exhibition Rule, aimed at general convenience, reduction of expenses and the better carrying out of the Rule. The great majority of electrical exhibitions for the display of electrical heating and cooking apparatus are now promoted by the supply authorities, and a large number of those authorities are members of the Electrical Development Association. That Association has now adopted a form of address to promoters pointing out the need for providing such facilities as will induce the manufacturer to become a willing exhibitor, the main one being that his expenses should be limited to cost of carriage, stall attendance, demonstrators, and reconditioning of exhibits. It is believed that this procedure will win the assent of supply authorities and thereby greatly assist the administration of your Exhibition Rule in so far as heating and cooking displays are concerned. Your Council recently had before them the question as to organising a National Electrical Exhibition in 1931—the year of the Faraday celebrations and other important functions, but decided that the general outlook for trade was not such as to warrant the large outlay necessary. As will be recalled, your Association organised the electrical and allied industries section of the British Empire Exhibition at Wembley in 1924, and it is felt that in view of the large expenditure then incurred (chiefly by members), amounting to over a million sterling, a further period should elapse before your Association again undertakes the organising of a large electrical exhibition. This, however, does not preclude co-operation with the E.D.A. and other organisations in any exhibition covering the applications of electricity rather than a display of generating plant, switchgear, and apparatus."

Institution Notes.

Institution of Electrical Engineers.

Informal Meeting.—At the informal meeting of the Institution on March 18th, Mr. J. F. Shipley was in the chair, when Mr. C. Turnbull opened a discussion on "Method in Invention," and a novel and most interesting treatment of engineering ideas was the result. The predominant note of his opening speech was that one must get rid of the idea that invention comes mainly from inspiration. Mr. Turnbull would have us keep a reference library of ideas, and then endeavour to adapt, or construct, inventions with them. A set of fourteen headings which he called "Operators" suggested the lines upon which ideas might be scheduled, and applied to various problems. The names of some of the headings indicated the ingenuity of the treatment:—(1) the Analytical Operator, (2) the Change of Position Operator, (3) the Addition Operator, (4) the Transference and Analogy Operator, (5) the Converse and Inverse Operator, &c. Mr. D. B. Hoseason explained the organisation and liaisons of a large research department in a modern works; he, too, held the view that much invention was really organised development. Messrs. J. H. C. Brooking, D. A. Christian, W. A. Erlebach, R. L. Graseby, A. N. D. Kerr, G. D. Malcolm, A. Morgan, E. W. Moss, F. Ockenden, A. W. Saulter, W. S. Saville, J. F. Shipley, and H. Wilson also spoke.

Benevolent Fund.—The late Dr. C. S. du Riche Preller, M.I.E.E., of Edinburgh, bequeathed by his will the sum of £100 free of duty to the Benevolent Fund of the Institution.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

B.E.A.M.A. Council Changes.—At the annual general meeting of the British Electrical and Allied Manufacturers' Association on March 21st, Col. R. K. Morcom, C.B.E., the retiring chairman, presented the report, and made reference to the difficulties of the past year. He announced the result of the ballot electing the following five members to the Council, 1929, to fill the seats vacated under the statutory rule: Brush Electrical Engineering Co., Ltd.; D.P. Battery Co., Ltd.; Electromotors, Ltd.; Ferranti, Ltd.; and Worthington-Simpson, Ltd. At a subsequent Council meeting Mr. Victor Watlington, M.B.E., managing director of the English Electric Co., Ltd., was elected chairman of the Council for the session.

During the past year Mr. H. I. Brackenbury (C. A. Parsons and Co., Ltd.) and Mr. W. O. Smith (Elliott Bros. (London), Ltd.) retired from the Council on account of illness, and their places were filled by Messrs. F. G. H. Bedford and L. W. Smith, respectively. Mr. F. H. Nalder (Nalder Bros. and Thompson, Ltd.) and Mr. A. P. Wood (Lancashire Dynamo and Motor Co., Ltd.) have been in temporary retirement for some months from the same cause, and their places have been taken by Messrs. A. F. Harris and J. G. Shaw, respectively. Mr. A. McKinstry joined the Council in the place of Capt. R. S. Hilton for the Metropolitan-Vickers Electrical Co., Ltd.; and Mr. A. Berkeley (Micanite and Insulators, Ltd.) and Mr. T. C. Pulman (Worthington-Simpson, Ltd.) were co-opted members. Mr. Frank Dudley Docker, C.B., has been appointed a vice-president.

Accompanying these notes we give a photograph of Mr. Richard Hodding Fox, solicitor to the Central Electricity Board, who, as mentioned on p. 482 of our issue of March 15th,

Mr. R. H. Fox,

Secretary and Solicitor to the Central Electricity Board.

has been appointed to be Secretary and Solicitor to the Board in place of Sir John Brooke, who has become an Electricity Commissioner.

Mr. Robert Lee, electrical engineer at St. Helens, has been recommended for the post of electrical engineer to the Stockport Town Council. Mr. Lee, after being at Stockport for 24 or 25 years, left it last year, when he was deputy engineer, for his post at St. Helens.

The directors of the Gramophone Co., Ltd. ("His Master's Voice") announce the election to the board of Senatore Marconi and Mr. David Sarnoff, the executive head of the Radio Corporation of America.

Admiral H. W. Grant has relinquished his position of joint managing director of the Eastern Telegraph Co., Ltd., consequent upon the arrangements under the merger. He retains his seat on the board.

M. Arth Sadzot has been appointed general director of the Belgian Telegraph and Telephone Department.

The authorities of the Technical High School of Aix-la-Chapelle have awarded the diploma of Honorary Doctor Engineer to Herr Hermann Sinnhuber of the North German Cable Co. in recognition of his work in connection with electric cable and wireless-telegraphy development.

M. P. L. Boulanger, director of the French Telegraphs, has been appointed vice-director of the Bureau International de l'Union Télégraphique.

Sir E. Wyldbore-Smith has been elected a director of the Metropolitan Railway Co. in place of Sir Harry Verney resigned.

The *Financial Times* says that Mr. Louis Beale, H.M. Trade Commissioner in New Zealand, has been appointed director of the Travel Association of Great Britain and Northern Ireland.

Mr. R. E. Jeffrey has resigned from the staff of the B.B.C. in order to take charge of the Sound Production Department of British International Pictures, Ltd., where he will explore various problems in connection with "talking pictures."

The Walton-on-Thames Urban Council has increased the salary of the electrical engineer, Mr. A. E. Anderson, to £600 per annum.

The Bury, Lancs., Town Council has appointed Mr. A. C. Fenwick, engineer and general assistant to the tramway manager at Dundee, as general manager of the Corporation Tramways at a salary of £650 per annum, rising to £750. There were 25 applicants for the post. Mr. Fenwick has been with the Dundee Corporation since 1911.

The Cape Town Electricity Committee has recommended that the City Electrical Engineer be granted three months' vacation leave as from June 7th, and that thereafter he proceed on service overseas for a visit to America and to attend the World Engineering Conference in Tokio, such an arrangement enabling him to resume duty towards the end of the current year.

The Secretary for Mines has appointed the following gentlemen to be members of the Safety in Mines Research Board: Major D. H. Cuprer Briggs, Mr. G. D. Budge, and Mr. Thomas Cape, M.P.

Mr. James A. Robertson, M.I.E.E., consulting engineer, has been elected president of the Manchester Association of Engineers.

Mr. A. S. Markes, A.M.I.E.E., has joined the fittings department of Veritys, Ltd., at King Street, Covent Garden, W.C.2.

Glasgow Corporation Special Committee on Wages and Salaries has approved of the salary of Mr. Christopher S. Murray being fixed at £340 per annum, on his appointment as principal book-keeper in the electricity department.

Obituary.—Dr. L. Sells.—The death occurred recently, at the age of 52 years, of Dr. Lionel Sells, an X-ray expert. He was admitted to St. Thomas's Hospital suffering from an advanced stage of X-ray carcinomatosis, and death was due to that complaint and loss of blood. The evidence showed that Dr. Sells's death was entirely due to his subjecting himself to the use of X-rays. He knew for years his condition, but persisted in his work as long as he was able. A verdict of "Death from Misadventure" was recorded.

M. Pavie.—The death recently occurred in Paris of M. Pavie, vice-president of the Compagnie Française Thomson-Houston.

Mr. B. F. Tapsfield.—The death has taken place at the age of 42 years of Mr. Bernard Frederick Tapsfield, who was for a number of years on the staff at the Canterbury municipal electricity works. He was previously at the Swansea electricity works for over eight years.

Mr. W. S. Rouse.—The death is announced at the age of 26 years of Mr. Wilfred Sydney Rouse, who had since 1918 been with the North Metropolitan Electric Power Supply Co. At the time of his death he was assistant electrical engineer to the company at Hoddesdon, Herts.

Mr. H. H. Gardam.—We regret to learn of the death of Mr. Harry H. Gardam, of Messrs. Harry H. Gardam & Co., Ltd., engineers and machinery merchants, of Staines. Mr. Gardam passed away after three days' illness following an operation. We are informed that the business of the company will be continued as usual by his co-directors.

Will.—Mr. R. M. Horne-Payne, founder and chairman of the British Columbia Electric Railway Co., has left £139,125 gross and £116,039 net personalty.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Solaflex Signs, Amalgamated, Ltd.—Registered as a public company March 16th. Capital, £125,000 in 5s. shares (300,000 "A" and 200,000 "B"). Objects:—To adopt agreements (1) with Solaflex, Ltd., (2) with Berry's Electric (1928), Ltd., and H. H. Berry, (3) with the Luna Advertising Co., Ltd., C. Gold, and the Partington Advertising Co., Ltd., (4) with Berry's Electric (1928), Ltd., (5) with Maxwell Hicks and Co., and (6) with Shaw, Loebl & Co.; to develop and turn to account the patents, patent applications and rights, licences and options and stocks relating to daylight signs, and to carry on the business of manufacturers of advertising signs, window displays and the like, electric motors, machinery and plant, electrical installations, &c. The directors are:—W. M. Kirkpatrick, "Terlings," Gilston, Herts., merchant; Sir Maxwell Hicks, C.B.E., 12, Grosvenor Gardens, S.W.1 (chairman of Solaflex, Ltd.); H. H. Berry, M.I.E.E., G2, Albany, Piccadilly, W. (chairman of Berry's Electric (1928), Ltd.); C. Gold, J.P., Stansted, Essex (chairman of Luna Advertising Co., Ltd.). Registered office: 12, Grosvenor Gardens, S.W.1.

British Dominions Power Syndicate, Ltd.—Registered as a private company March 16th. Capital, £50,000 in £1 shares (25,000 "A" and 25,000 "B"). Objects:—To form, promote, and assist companies, syndicates, and partnerships to carry on all or any of the businesses of electrical and general engineers and manufacturers, and maintainers of plant for the generation, accumulation, transmission, and supply of electrical energy for light, heat, power or otherwise, to carry on business as electricians, electrical, hydraulic, mechanical or general engineers and contractors, suppliers of electricity and that of financiers, underwriters, concessionaires, &c. The subscribers (each with one "A" share) are:—E. L. Davies, 1a, Herbert Road, Plumstead Common, S.E.18, clerk; E. J. Burrows, 29, Lyndhurst Road, Highams Park, E.4, clerk. Solicitors: Herbert Smith & Co., 62, London Wall, E.C.

Welding Equipment, Ltd.—Private company. Registered March 18th. Capital, £1,000 in £1 shares. Objects:—To acquire the business now carried on at Yorkshire Street, Salford, as the Welding Equipment Co., and to carry on the business of manufacturers of and wholesale and retail dealers in welding and electrical equipment, &c. The directors are:—G. Davies and H. Davies, both of Chatsworth Road, Ainsdale, Liverpool. Registered office: 20, St. Ann's Square, Manchester.

Park Electric Radio Productions, Ltd.—Private company. Registered March 15th. Capital, £1,000 in £1 shares. Objects:—To carry on the business of manufacturers and producers of, and dealers in apparatus, instruments, machines and materials of all kinds for use in connection with radiotelegraphy or telephony, &c. The subscribers (each with one share) are:—R. G. Willis, 15, Palace Court, Hampstead, N.W.4, company director; H. R. Ross, 14, Basing Hill, Golders Green, N.W.11, company director. Solicitors: Godden, Holme & Ward, 34, Old Jewry, E.C.

Motor Lamps, Ltd.—Private company. Registered March 16th. Capital, £21,000 in £1 shares. Objects:—To acquire the patents and provisional patents relating to motor lamps and lens belonging to P. Allman and A. W. Pougher, and to carry on the business of manufacturers of, agents for, and dealers in motor lamps, drawn wire, electric cabling, electric lamps, &c. The subscribers (each with one share) are:—P. Allman, 14, West Meade, Chorlton-cum-Hardy, Manchester, technical director; A. W. Pougher, 63, Ayres Road, Old Trafford, Manchester, managing director. Registered office: 17, Balfour House, 119, Finsbury Pavement, E.C.2.

Mavor & Coulson (South Africa), Ltd.—Private company. Registered in Edinburgh on March 19th. Capital, £10,000 in £1 shares. Objects: To carry on the business of engineers and electricians, merchants, agents, dispatch and financial agents, shipowners, warehouse keepers, &c. The directors are:—S. M. Mavor, 47, Redan Street, Mile End, Glasgow, engineer; E. I. Mavor, 47, Redan Street, Mile End, Glasgow, accountant; G. M. Gullick, Richmond Hill, Handsworth, Sheffield, engineer; J. B. Mavor, 79, Oakfield Avenue, Glasgow, engineer; A. W. Davies, The Croft, Carmyle, Glasgow, engineer; W. B. Hird, 86, Talbot Terrace, Scotstownhill, Glasgow, W.3, engineer. Registered office: 47, Redan Street, Mile End, Glasgow.

British Automatic Refrigerators, Ltd.—Registered as a public company March 22nd. Capital, £250,000 in 340,000 10 per cent. participating preferred ordinary shares of 10s. each and 800,000 deferred shares of 2s. each. Objects:—To adopt agreements with the British Automatic Refrigerator Co., Ltd., and others, and to carry on the business of engineers, manufacturers of, and dealers in all articles and appliances for domestic or commercial use, including refrigerators, refrigerating machines, &c. The subscribers (each with one share) are:—E. J. Edwards and S. E. Weber-Brown, 17, Billiter Street, E.C.3, solicitors, and five clerks. Registered office: 82, Victoria Street, S.W.1.

Official Returns of Electrical Companies.

Axuel Time Switches, Ltd.—L. Macandrew, 9, The Avenue, Ealing, W., was appointed receiver and manager on March 11th, 1929, under powers contained in debenture dated March 20th, 1928.

Saunders Electrical Co., Ltd.—R. B. Leech, 23, Warwick Row, Coventry, was appointed receiver and manager on March 9th, 1929, under powers contained in first mortgage dated May 23rd, 1922.

H. Lewis, Ltd.—W. F. Whiting, Bridge Buildings, Nene Quay, Wisbech, ceased to act as receiver and manager on January 31st, 1929.

Gilfillan Bros., Ltd.—C. E. Smedley, Bush Lane House, Bush Lane, E.C.4, ceased to act as receiver or manager on February 16th, 1929.

Belbin & Bowden, Ltd.—A. C. Read, 159, Queen Victoria Street, E.C.4, was appointed receiver and manager on March 8th, 1929, uunder powers contained in debenture dated January 28th, 1929.

Siderman Electrical Supplies, Ltd.—J. Stone, "Legality," Canvey Island, was appointed receiver on February 19th, 1929, under powers contained in debenture dated May 9th, 1927.

English Electric Co., Ltd.—Satisfaction to the extent of £43,600 on October 25th, 1928, of first mortgage debentures secured by trust deed dated September 15th, 1919, securing £1,000,000.

Nefa Co., Ltd.—Capital, £1,000 in £1 shares. Return dated January 14th, 1929. 999 shares taken up. £999 paid. Mortgages and charges, £500.

Shipton Automatic Telephone System, Ltd.—Capital, £100 in £1 shares. Return dated January 11th, 1929. 3 shares taken up. £3 calls unpaid. Mortgages and charges, nil.

Rowlands Electrical Accessories, Ltd.—Capital, £1,000 in £1 shares. Return dated May 25th, 1927 (filed January 25th, 1929). 566 shares taken up. £566 paid. Mortgages and charges, nil.

Credenda Conduits Co., Ltd.—Capital, £50,000 in £1 shares. Return dated November 6th, 1928. All shares taken up. £30,000 paid. £20,000 considered as paid. Mortgages and charges, nil.

Townlea Electrical Co., Ltd.—Capital, £1,000 in 300 preference and 700 ordinary shares of £1 each. Return dated January 13th, 1929. 500 ordinary shares taken up. £500 considered as paid. Mortgages and charges, nil.

Brandes, Ltd.—Capital, £20,000 in £1 shares. Return dated November 14th, 1928. All shares taken up. £10,392 paid. £9,608 considered as paid. Mortgages and charges, nil.

C. B. King (Magnetos), Ltd.—Particulars filed of £1,100 debentures authorised March 12th, 1929, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Ernest F. Moy, Ltd.—Capital, £10,000 in 1,500 preference and 8,500 ordinary shares of £1. Return dated October 2nd, 1928. All shares taken up. £10,000 paid. Mortgages and charges, £6,000.

Lancashire Telephone Systems, Ltd.—Capital, £10,000 in 5,000 preference and 5,000 ordinary shares of £1 each. Return dated January 4th, 1929. 700 preference and 3,380 ordinary shares taken up. £3.642 10s. paid (being £1 per share on 3,205 ordinary, and 10s. per share on 175 ordinary and 700 preference). Mortgages and charges at date of return, nil. Since registered, £550 debentures (part of a series of £4,000 authorised February 1st, 1929).

International Hydro-Electric Development Syndicate, Ltd.—Capital, £10 000 in £1 shares. Return dated January 2nd, 1929. 2,744 shares taken up. £2,744 paid. Mortgages and charges, nil.

City Notes.

English Electric Co., Ltd.

The annual meeting was held on March 18th, Mr. W. L. Hichens (chairman) presiding. In moving the adoption of the report (*vide* ELEC. REV., March 15th, p. 486), the chairman said that the most striking change during the year was that whereas in 1927 there was a loss of £134,450 and, in addition, provision had to be made for certain exceptional losses, in 1928 there were no exceptional losses to be provided for, and the loss for the year had been reduced to £33,600—a reduction of over £100,000. The trading profit for 1927 had been £66,000 better than in 1926. The improvement therefore had been both substantial and progressive. He did not wish to suggest that the same rate of improvement would be maintained in future years, but there were, he thought, solid grounds for hoping that under normal conditions—that was if prices did not fall below the present low level, and if they were able to secure the same volume of orders as during the past year—they might look forward with confidence to continuing on the up-grade, although progress might be slower. If, however, the electrical industry expanded during the next few years, as many good judges anticipated, and they were able to obtain a fair share of the increased volume of work, then their improvement should be much more rapid. The improvement during the year was not due to an increased output, for the total invoicings for 1928 were lower than in 1927, although the actual orders received were slightly higher. Nor could it be explained by reason of better price levels, for in the heavier classes of electrical plant, with which their business was concerned, prices had fallen during 1928. It was sometimes suggested that prices in the electrical industry were artificially maintained at unreasonable levels, and that the consumer was being fleeced. In actual fact the reverse was the case, and it was the unfortunate electrical manufacturer who was being fleeced, so far as the heavier classes of electrical plant were concerned, whatever might be the case in respect of the lamp business and electrical accessories which were, undoubtedly, more fortunately placed. Speaking generally, there had been a fall during the past year of about 15 per cent. in certain sections of their business, whereas in others the drop had been as great as 30 per cent., and sometimes even 50 per cent.; in some cases prices were below the level of 1914. The value of the British export trade in electrical machinery had increased year by year. In 1928 the actual value was 31 per cent. above the actual figure for 1920, and if prices were equated to the level of 1920 the increase worked out at no less than 190 per cent. In view of the steady fall in the exports of some of the basic industries, it was satisfactory to note this expansion of the electrical industry, since foreign competition was very keen, and the wages paid in this country were higher than those of their Continental rivals. The company had secured an important share of this foreign business. At the last annual meeting he had referred to the large foreign orders that had been secured for them by the Power and Traction Finance Co. The 45,000-kW power station, which was under erection in the neighbourhood of Athens, and for which the English Electric Co. were the sole contractors, was nearing completion and, it was hoped, would be in operation in June this year. Considerable progress had also been made with the 65,000-kW power station which they were constructing in collaboration with Messrs. Ganz at Banhida, in the neighbourhood of Budapest. The Power and Traction Finance Co. had various other schemes under consideration, both abroad and in this country. It was promoting Bills at the present time in connection with two large hydro-electric schemes in Scotland, one in Galloway and the other in the West Highlands. It was to be hoped that those Bills would be as successful as the Lanarkshire Hydro-Electric Bill, promoted by the same company in 1924. It was clear that the improved results of 1928 were due not to better prices or a bigger turnover, but to greater efficiency. Important economies were introduced during the latter part of 1927, the full effects of which were felt in 1928. The overhead expenses of the company could not be cut much lower than at present without impairing efficiency, but there was still much to be done in the way of improving equipment and studying cheaper methods of manufacture and design. Much had been done in these directions during the past year, and it had contributed materially to the improved results. Having referred in detail to the figures in the balance sheet, nearly every item in which showed some improvement, the chairman said he thought that the conclusion was justified that the position of the company had been materially strengthened during the year, and a feeling of confidence in the future was warranted. Sir Charles E. Ellis seconded the motion, which was carried.

Enfield Cable Works, Ltd.

The annual meeting was held on March 20th, the Earl of Verulam (chairman) presiding. In proposing the adoption of the report for the eighteen months ended December 31st, 1928 (*vide* ELEC. REV., March 15th, p. 486) the chairman said that so far as the profit and loss account was concerned, a profit in eighteen months of £162,000 was equivalent to a profit in twelve months of £108,000, as compared with £102,000 to June, 1927, and £116,000 to June, 1926. After reviewing the accounts, he said that their investment in the Enfield Rolling Mills was still one which had not yet paid them a dividend, but the company was to-day earning a profit and proving itself to be a satisfactory investment. Apart from that they had all along had the benefit of sure supplies of copper rod at lowest prices, and this alone had made their Rolling Mill venture very well worth while to them. The Australian subsidiary had had another good year. There was a new item in the balance sheet, investments in other companies at cost, and whilst it was not expedient to specify the nature of the investment further than to say that it represented a holding in a cable company, he might say that the policy referred to in the report, of acquiring certain holdings in allied cable businesses, was resolved upon as following a tendency of the times and as being desirable if the Enfield company was to maintain its relative position in the cable-making world. It was not possible to stand still in a world where everything was in a constant state of flux, and he had no hesitation, therefore, in recommending to them the step which they were proposing to take. The return on their money should be satisfactory, and the benefits they might reap from the investment should be well worth any risk which might be involved. The investment, moreover, might prove to be only a step in the general evolution of business in this country. In consequence of this decision they were in need of a certain amount of new money. Had it not been so it would have been open to them to have issued, say, 50,000 new shares as a bonus free of cost. The alternative plan which they had adopted was to issue 100,000 new shares at £2, and this proposal he had no hesitation in recommending to the shareholders. Sir T. O. Callender seconded the motion, and the report was adopted. An extraordinary meeting followed, at which a resolution was agreed to increasing the capital to £800,000 by the creation of 350,000 new ordinary shares of £1 each. The chairman explained that the directors wanted to issue 100,000 new shares, partly for the purpose of obtaining fresh money and partly for the purpose of giving a bonus to the shareholders. They thought they would take the opportunity of creating 350,000 new shares, putting 250,000 of them aside for the time being.

Telegraph Construction and Maintenance Co., Ltd.

This company's report for 1928 was reviewed in our last issue (p. 533). The annual meeting was held on March 21st, when Lord Selborne (chairman) in the course of his address said that at the last meeting he had stated that the volume of their submarine cable work had been largely affected by the negotiations proceeding between the Government and the wireless and cable companies. Those negotiations had led to the merging of the various interests concerned, but as some time was necessary for the maturing of the plans the company's position had not yet altered materially. It was certain, however, that the cable systems would have to be maintained in full efficiency and that, in turn, meant the laying of loaded cables, which had fully proved their worth. Lower rates and increased use of letter-telegrams would necessitate more fast-working cables. The Western Union Telegraph Co. had realised this; in the autumn they manufactured a cable for that company which in addition to high speed was capable of being duplexed. The cable had been successfully laid between Bay Roberts and the Azores by the c.s. *Dominia*. Research work had now definitely established the fact that a long loaded telegraph cable of the ordinary type of construction could be adapted not only for telephony but for the far higher requirements of facsimile telegraphy. They had developed a method of dealing with their usual gutta-percha insulating material whereby its electrical characteristics rendered it suitable for those purposes. In order to test those advantages the International Standard Electric Corporation had given the company an order for two cables, one to be laid between Tenerife and Gran Canaria, and the other between Algeciras and Ceuta. Facsimile telegraphy was likely to become the most important form of communication in the future. The cable ships had been well employed during the year, and although their submarine-cable manufacturing business had been quiet they were in a satisfactory position owing

to provisions made in the past for contingencies and to their efficiency of production. Although the transition period had not yet passed, there were welcome signs of a revival in the demand for cables.

New Issue.

Berry's Insulating and Building Products, Ltd.—This company was recently formed with an authorised capital of £175,000 in 5s. ordinary shares to acquire the share capital of Berrite, Ltd., and to manufacture and sell electrical and heat insulating materials, bricks, tiles, &c. The chairman is Mr. A. F. Berry, chairman of the British Electric Transformer Co., Ltd., and Mr. F. E. Berry is also on the board. Last week the company made an issue of 528,000 shares at par; the balance of the shares (together with £55,000 in cash) are allotted to the vendor, Mr. A. F. Berry. The prospectus stated:—"An outlet for the company's products is assured for years to come by the rapid increase in the demand for electrically-equipped houses, especially for the 'Tricity' houses, each equipped with the latest adaptations of electricity to lighting, heating and cooking appliances, providing also cold storage, and each calling for upwards of 20,000 bricks and tiles in building, as well as other of the company's products. The Elthorne Works are in close proximity to the well laid-out Elthorne Heights Estate, which comprises over 800 freehold building sites, and is being rapidly developed, a large proportion of the houses being now built with up-to-date labour-saving devices. Some 300 houses have been built and sold on this estate during the last few years, and the demand is at present such that these 'Tricity' houses are being sold as soon as built."

Folkestone Electricity Supply Co., Ltd.

The annual meeting was held on February 22nd. In presenting the report and accounts (*vide* our last issue,, p. 533), the chairman (Ald. G. Spurgen, J.P.) referred to the issue of 35,000 new ordinary shares and 2,500 co-partnership shares made during the year. Their capital expenditure increased year by year, showing that the company was progressing, and this was confirmed by the growing maximum demand and output. After reviewing the accounts, the chairman said that the depreciation fund was being steadily built up to a figure commensurate to the, at present unknown, claims that might be made upon it. The employés' superannuation scheme was now in being, and they hoped in course of time to make the fund solvent for all their employés, no matter what their length of service was. The board had lodged an appeal against the re-assessment of their properties which showed an increase of some 350 per cent., as compared with a general increase of about 20 per cent. With regard to the future, it appeared that there was nothing to interfere with the steady progress of the company.

City of London Electric Lighting Co., Ltd.

Presiding at the annual meeting on March 20th, Mr. J. B. Braithwaite (chairman) said that under the London Electricity (No. 1) Act, 1925, the Electricity Commissioners had fixed the company's standard prices to private consumers at 3.069d. per kWh, and for street lighting at 0.794d. per kWh. The consumers' benefit during the three years which had elapsed since the passing of the Act had amounted to nearly £600,000. The output showed an increase of 8,400,000 kWh, as compared with an increase of 5,000,000 kWh in the preceding year. In 1921 the average price charged was 4.37d. per kWh, and this had been gradually reduced to 2.23d. in 1929—a reduction of 49 per cent. The gross revenue from private consumers was reduced by £7,417, in spite of the increased output, but this was due to reductions made in the electricity tariffs. The connections had increased by 4,768 kW to about 10,000 kW. The company's Bankside power station had been chosen by the Central Electricity Board as one of the "selected" stations. The report and accounts were adopted.

Newcastle and District Electric Lighting Co., Ltd.

The annual meeting of this company, whose accounts for 1928 were reviewed in our last issue (p. 533), was held on March 22nd. The chairman (Col. F. R. Simpson) said that the sales of energy had increased by 8 per cent. during the year, which was satisfactory in view of the fine summer and mild autumn. The proceeds of the issue of 150,000 £1 shares made during the year were to be devoted to redeeming the 6½ per cent. third mortgage debentures, repaying temporary loans, and to the development of the company's business. The directors had reduced the charge for electricity for domestic purposes, and this and the forthcoming North-East Coast Exhibition should lead to increased consumption. The chairman regretted that the company would derive no relief from the new Rating Act; the amount paid in rates last year was £10,000. Over £36,000 had been spent on capital account, of which £22,000 was represented by mains.

Para Electric Railways and Lighting Co., Ltd.

The net revenue and interest received for the past year amounted to £71,192, against £69 832 in 1927. After deducting debenture interest, &c., and London expenses, there is a credit balance of £28.804 (against £97.662). To this is added £5.698 brought forward, making £34,502. The usual charges are met and the balance of the preference dividend is paid, leaving £5,001 to be carried forward.

Companies Struck off the Register.

The names of the undermentioned companies have been struck off the Register, and they are thereby dissolved:—

Acme Radio Valve Co., Ltd.
B. Barnett (Electrical Engineers), Leyton, Ltd.
Burke Electrical Manufacturing Co., Ltd.
Chase Electrical Manufacturing Co., Ltd.
Codd Arc Lamp Co., Ltd.
Electric Distributing Co., Ltd.
International Radio Manufacturers, Ltd.
Johnson Radio Co., Ltd.
Lang Squire Wireless Manufacturing Co., Ltd.
Little-Carden Power Units, Ltd.
Northern Wireless Schools, Ltd.
Premier Electrical Supplies, Ltd.
Yera Electrical, Ltd.

Official Notice *re* Company.

The name of the undermentioned company will be struck off the Register at the expiration of three months unless cause is shown to the contrary:—

Forward Electric Co., Ltd.

County of Durham Electrical Power Distribution Co., Ltd.

The report for the year ended December 31st, 1928, shows a profit of £59,299, against which interest has been charged on debenture stock, loans, &c., amounting to £26,862, leaving a balance of £32,437. Adding the balance of £886 brought forward from 1927 there is a total available profit of £33,323, which the directors recommend should be appropriated in payment of a dividend of 6 per cent. on the ordinary shares, which will absorb £32,100, and in carrying forward £1,223. The additional capital expenditure has amounted to £69,507. The accounts show that the company's holding of 45,910 shares of £10 each in the County of Durham Electric Power Supply Co. is valued at £367,395, and the revenue received from that company was £30,989.

Stock Exchange Notices.

The undermentioned have been ordered to be officially quoted:—

Ever-Ready Co. (Great Britain).—296,000 ordinary shares of 5s. each, fully paid, Nos. 1,680,001 to 1,976,000.

International Telephone and Telegraph Corporation.—243,200 shares of capital stock of $100 each.

North Metropolitan Electric Power Supply.—325,000 ordinary shares of £1 each, fully paid, Nos. 1,275,001 to 1,600,000.

Northampton Electric Light and Power.—100,010 ordinary shares of £1 each, fully paid, Nos. 522,491 to 622,500.

Waste Heat and Gas Electrical Generating Stations, Ltd.

The directors' report for 1928 shows a net profit of £28,470, as compared with £28,348 in 1927. To this is added a net amount of £15,044 brought forward, making £43,514. The dividend on the ordinary shares is again 8 per cent. (2½ per cent. having been paid in August last), and £17,914 is carried forward. The output of the power stations in operation during the year was satisfactory. The Newport station has now been handed over to the Newcastle-upon-Tyne Electric Supply Co., Ltd., under the terms of the agreement with that company. The Tees Bridge station has been dismantled owing to the permanent closing down of the furnaces from which the waste heat was obtained.

Foundation Co., Ltd.

An extraordinary meeting was to be held this week to consider resolutions providing for the cancelling of the participating rights of the 8 per cent. cumulative preference shares; and raising the capital to £500,000 by the creation of 150,000 additional 8 per cent. cumulative preference shares. As compensation for the loss of their participating rights the holders of the old and new preference shares are to receive one ordinary share for each five preference held. The ordinary shareholders were to be asked to surrender sufficient shares to enable the arrangement to be carried out.

Radio Corporation of America.

The total gross income from all sources rose from $65,418,620 in 1927 to $101.851,603 last year, and the net income from $11,799,650 to $23.661,989. The amount carried to surplus after meeting all charges was $19,834,798, as compared with $8,478,319 in 1927, when $750,000 was put to reserve. The report states that for the first time the communications business earned sufficient to meet the preferred stock dividends. The Corporation has already entered the gramophone business, and proposes to participate in the domestic telephone field.

Atlas Light and Power Co., Ltd.

From the proceeds of the sale of the company's Argentine properties it is proposed to redeem the whole of the outstanding debenture stock amounting to £2,567,600. The stock will be repaid at 105 per cent., plus accrued interest, on May 1st. The holders will be given the option of exchanging their stock

for new 5 per cent. debenture stock. This will be offered on the following terms: £111 of new stock for each £100 of the old; or £100 of new stock and a cash payment of £10 5s. for each £100 of old stock.

Ericsson Telephones, Ltd.

The directors report a profit of £31,011 for the year ended December 31st, 1928, as compared with £27,004 in 1927. The profit was arrived at after writing down the value of stocks and expending £15,605 on the maintenance of plant and buildings. An ordinary dividend of 5 per cent. is recommended, as for 1927, the reserve again receives £5,000, and £18,235 is carried forward. The report states that trading conditions improved slightly, although prices continued to be very competitive. Meeting: April 3rd.

Einstein's Electro-Chemical Process, Ltd.

At the statutory meeting on March 20th the chairman (Col. the Master of Sempill) referred to the "ill-informed criticisms" of the company and maintained that in the Einstein process the company had a valuable commercial proposition. An announcement was issued after the meeting that as the company had ample cash resources for its immediate needs the final call of 5s. on the preference shares would be postponed for the present.

Greengate & Irwell Rubber Co., Ltd.

The net profit for the past year amounted to £87,607 (as compared with £91,632). The addition of income from investments and £24,379 brought forward makes available £117,506. It is proposed to pay a final ordinary dividend of 1s. 6d. per share, making 2s. 6d. for the year (against 2s. 3d. for 1927); £20,000 is again placed to reserve and £22,506 remains to be carried forward.

Scottish Tube Co., Ltd.

To a credit balance of £1,523 for 1928 there is added £20,819 brought forward, making £22,342. After meeting debenture interest, &c., and transferring £15,000 from reserve, the 5 per cent. preference dividend is paid and £6,530 is carried forward. The directors state that the results do not justify the payment of an ordinary dividend.

J. Stone & Co., Ltd.

The past year's profit amounted to £243,459 (against £234,555 in 1927), and a balance of £128,388 brought forward is added, making £371,847. The reserve again receives £50,000, and the ordinary dividend is raised from 15 to 20 per cent., leaving £162,767 to be carried forward.

Bogota Telephone Co., Ltd.

The directors announce that in view of the reconstruction programme at present in hand, and of the non-settlement of the tariff question with the Bogotà municipality, they have decided to defer consideration of the payment of a dividend until the accounts of the current year's working are available.

Associated Telephone and Telegraph Co.

The following quarterly dividends have been declared:—First preferred stock, $1.75 per share; Classes "A" and "D" stock, $1 per share; Class "C" stock, $0.75 per share.

Ward & Goldstone, Ltd.

Our reference in our issue of March 22nd to this company's dividend should have read: Interim dividend of 3¼ per cent., namely, at the rate of 7 per cent. per annum.

Direct Spanish Telegraph Co., Ltd.

The dividend for 1928 on the ordinary shares is again 10 per cent., free of tax. An interim distribution of 4 per cent. was made in October last.

Montreal Light, Heat and Power Consolidated.

A dividend of 60 cents per share has been declared on the common shares for the quarter ending March 31st.

Montreal Tramways Co.

The gross receipts for 1928 amounted to $14,938,678 and the net receipts to $3,435,363.

German Companies.

The *German Atlantic Telegraph Co.* recommends the payment of a dividend of 7 per cent., as for 1927. The traffic is reported to have increased further, especially on the line between Emden, the Azores and New York. The question of the laying of a further cable between Emden and the Azores is under consideration.

The *Voigt and Haeffner Co.*, Frankfort-on-Main, after setting aside 780,000 marks for depreciation in 1928 as against 550,000 marks in the previous year, reports net profits and balance forward amounting to 809,000 marks as compared with 730,000 marks in 1927. It is proposed to pay a dividend of 9 per cent., against 8 per cent. for 1927.

Rangoon Electric Tramways and Supply Co., Ltd.

A final ordinary dividend of 1 rupee 4 annas has been declared, free of Indian income tax, making 1 rupee 12 annas for the year, as in 1926-27.

Stocks and Shares.

Monday Evening.

The Stock Exchange does not expect to be busy in the week before Easter, and in this present year various reasons conspire to deepen the quietude which prevails in Throgmorton Street. The position as regards the money market is anything but happy. Loan rates in America have risen into two figures, and there is still a lurking fear lest the Bank of England may have to increase its minimum of 5½ per cent. People seem to think that the General Election will take place on May 30th, although rumours of a postponement have been current.

Cable Boomlet.

An outstandingly pleasant feature in our lists this week is shown by the Eastern Cable group, very considerable rises having occurred on the expectation that the details are to be made known directly after Easter in respect of the new stocks that the three companies—the Eastern, Eastern Extension and Western—will be given in exchange for the present securities. Eastern ordinary gained 10 points. The others in the quartette are 15s. to £1 higher. The amount of stock that was purchased could not be described as substantial, although its effect proved to be so material. Marconis went 1/16 better, to 4¼, on the same assumption, and Marconi Marines at 3¼ are also harder, allowing for deduction of the dividend. Canadian Marconis lost 3s. 9d. at 35s. Reverting to the cable issues, Great Northerns at 32½ have regained their last week's loss. The Direct Spanish Telegraph has declared 10 per cent. dividend on its preference shares, less tax, and on its ordinary shares, free of tax. The former stand at 7½, and the latter at 103½. Both are £5 shares.

New York's Telephones.

The New York Telephone Company, in its report, says that additional funds needed were borrowed from the American Telephone and Telegraph Company, and refers to the inauguration of a Transatlantic service by the latter company and the British Post Office in 1927. The New York Telephone Company remarks that it is now possible for customers to communicate with 85 per cent. of the telephones in the entire world. The average number of daily calls handled during 1928 was 11,393,000, an increase of three-quarters of a million. The dividend on the common stock for last year is 8 per cent. The company's 4½ per cent. bonds are quoted in London at 99. International Telephone and Telegraph stock is 24 points better on the week, at 249. American Telephone and Telegraph at 219 is somewhat reactionary, having been up to 223.

Electricity Supply.

Rumours have been current to the effect that the British Shareholders Trust, Limited, is preparing a new issue of shares from the Midland Counties Electric Company, and at the time of writing, details are awaited with considerable interest, the company being one around which lively public attention revolves. The price of the shares is 6d. better at 28s. Midland Electric Power lost 3s. 9d., at 36s. 3d., as a sequel to disappointment with the dividend of 8 per cent.. The effect of the spring dividend declarations has been almost negligible in the London group of companies. The County of London announcement, making 10 per cent. for the year, was regarded in the market as being satisfactory, and a mild decline in the price was soon recovered. It was asked, by some, whether holders had expected a bonus issue of shares, and no doubt something of this sort has been in mind for some time past. The dividend itself, 2½ per cent. better than that of 1927, is supplemented by an appropriation in respect of the company's extra-London interests, and the same announcement is made in regard to the South Metropolitan Electric Light and Power, where the dividend of 5½ per cent. makes 8½ per cent. for the year.

At the meeting of the City of London Electric Lighting Company, the Chairman (Mr. J. B. Braithwaite) showed that the company already had an increase of over 6 million units as compared with the corresponding period of last year. On this announcement, City "Lights" ordinary and preference regained the dividend deductions that had been made.

The Clyde Valley Electrical Power Company announces a profit of £304,300 for 1928, being about £16,000 better than that of the previous year. The dividend on the ordinary shares is maintained at 8 per cent., and the price of the shares rose 1s. to 41s. Electric Supply Corporation ordinary eased off to 55s. Yorkshire Electrics lost 1s., at 34s., people selling these, apparently in order to take up the new shares.

G.E.C.

The General Electric affair continues to attract attention, although the excitement and the heat engendered by the company's previous action have given way to a calmer feeling now that the company has consented to negotiate with the American interests. The price of the shares has gone back to £3, which shows a fall of 5s. on the week. American Utilities have been flat by reason of the monetary situation in New York, which led to free selling on the other side. London is not an eager buyer of dollar stocks at present, the consequence being that a few of the principal issues are down on the week. Power Corporation of Canada at 105 are 10 points lower. Shawinigan common shares shed 6 points, being lowered to 81¼. British Columbia Power "A" show a fall of 2, at 51, and the "B" drooped to 31. Mexico Tramways gave way to 47½. The 5 per cent. bonds are down 6 to 71¼. Mexican Light and Power issues keep tolerably firm. Sidros at 15⅜ are easier. Brazilian Tractions lost 6, at 61, and the preferred fell to 210. Montreal Light and Power at 107 is 3 lower.

Associated Electrical.

Prices of shares in the manufacturing division are slightly better. British Aluminium ordinary strengthened to 47s. 6d. on the issue of the report for 1928, the profit of £441,383 being £9,200 up. The dividend of 10 per cent. is maintained, and the carry-forward increased to £33,843. Callenders improved to 4⅜. India-rubber shares rose ⅛ to 13s. 9d. English Electrics gave way to 7s. 6d. Further contracts for work, approximately £1,500,000, have been placed by the Central Electricity Board in connection with three of its schemes. The most active shares in the manufacturing section are those of the Associated Electrical Industries, Ltd. A week ago the price was 33s. Since then, it has been run up to 38s. on urgent American buying. Out of the company's authorised ordinary capital of £5,025,000, in shares of £1 each, £3,498,000 has been issued. There are also 616,525 8 per cent. cumulative preference shares of £2 each in issue, out of an authorised 685,000 shares. The company holds a controlling interest in Metropolitan-Vickers, British Thomson-Houston, Edison Swan and Ferguson Pailin.

Para Electric.

The report of the Para Electric Railways and Lighting Company exhibits a moderate increase in net revenue at £71,200. The company is paying 3 per cent., making the full 6 per cent. for the year, on its preference shares. A month ago, the ordinary stood at 4s., and the preference at 17s. The current prices are 6s. 6d. and 20s., respectively, both lower than the figures of a week ago.

Home Rails and Traction.

Without much business afoot in the Home Railway market, prices keep firm, and Underground Incomes show a gain of 2. The shares strengthened to 25s. before easing off to 23s. 6d., which is ex dividend. Districts are better at 76½. Metropolitan Surplus Lands bonds dropped to 76. A fall of 75 points in British Electric Traction deferred stock would look more spectacular were it not for the pyrotechnical rises that the price enjoyed, week after week, in the earlier part of this year. London United Tramways preference continue at 8s. Metropolitan Tramways ordinary last changed hands, ten days ago, at 5s. 6d.

Stocks and Shares on Offer.

A couple of thousand Charing Cross Electric 4½ per cent. preference can be bought at 18s., to pay 5 per cent. on the money, and in their class they are practically gilt-edged. General Electric 7½ per cent. "B" preference are available to the extent of two or three thousand shares at 26s. 9d., these yielding £5 12s. 3d. per cent. Dividends are due at the end of June and December. Good cover exists for 500 Isle of Thanet Electric Supply 6 per cent. preference, which stand at 26s. 6d., and yield 4½ per cent. on the money. The attraction here is that the shares rank equally for dividend with the ordinary after the latter receive 6 per cent. For 1928, the ordinary shares were paid 4 per cent., and expectation looks to the preference becoming entitled to participation rights within the next few years. Scottish Power 6 per cent. preference can be bought at 22s. 9d., to pay £5 5s. 6d. per cent. on the money.

Miscellaneous.

Ever-Ready shares have rallied to 22s. 3d. Kolster-Brandes at 13s. 9d. show ¼ decline. Burndept Wireless have been changing hands around 5s. 6d. The iron and steel group has hardly budged; Vickers are still dullish at 11s. 7½d. Rubber shares weakened on account of another shrinkage in the price of the produce. Business in them has dwindled once again to a minimum.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom. £	Dividend. 1926.	Dividend. 1927.	Price March 25 1929.	Rise or fall	Yield p.c.
Bournemouth and Poole	1	14†	15	65 9	−1/16	... ...
Brompton Ordinary	1	8⅜	8½	27/-	—	5 3 8
Charing Cross Ordinary	1	8½	8½	26/-	—	5 7 8
do. do. 4½% Pref. ...	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8¼	8¼	27/-	—	5 3 8
City of London	1	10	10	32/-xd	+9d.	4 7 6
do. do. 6% Pref.... ...	1	6	6	23/-xd	+6d.	5 4 4
Clyde Valley	1	8	8	41/	+1/-	3 18 1
County of London	1	7½	7½	53/-	—	2 16 7
do. do. 6% Pref.... ...	1	6	6	23/-	—	5 4 4
Edmundson's 7% Pref.	1	7	7	25/-	+6d.	5 12 0
Elec. Supply Corporation	1	11	11	55/-	−1/16	4 0 0
Kensington Ordinary	1	8	8	26/6xd	—	5 5 8
Lancs. Light and Power	1	7½	7½	30/-	—	5 0 0
London Electric	1	8½	8½	27/-xd	—	5 3 8
Metropolitan	1	8	9	21	—	4 4 8
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6	6½	28/-	+6d.	4 12 10
Mid. Elec. Power	1	—	15	36/3	−3/16	4 2 9
Newcastle on-Tyne Ordinary ...	1	5	6	1¼	—	4 16 0
do. 7% Pref.	1	7	7	26/-	—	5 7 8
Notting Hill 6% Pref.	10	6	6	10⅞	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	23/-	—	5 4 4
St James' and Pall Mall	1	8	8	27/6	—	5 1 10
Scottish Power	1	8	8	31/-xd	−9d.	5 3 3
South London	1	8½	8½	27/6	—	5 2 8
Urban Ordinary	1	7	7	44/6	—	... ...
Westminster Ordinary	1	8½	8½	26/-	—	5 7 8
Whitehall Elec. Invst. 7½% Pref. ...	1	7½	7½	23/6xd	−9d.	6 7 8
Yorkshire Elec.	1	8	8	34/-	−1/-	4 14 2

†4% of which was tax free.

Home Rails.

Central London Ord. Assented ...	Stock	4	4	72	—	5 11 1
Metropolitan	,,	3	3	60	—	5 16 8
do. District	,,	3½	4	70½	+½	6 10 9
Underground Electric	£1	1½	5	23/6xd	—	5 19 2
do. do. Income ...	Bonds	6	6	113	+2	5 6 1

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	Stock	6	6	108	—	5 16 6
do. Def.	,,	1½	1½	24	—	6 3 9
Automatic Telephone	1	10	10	2⅛	+1/16	5 14 2
Eastern Extension	10	10	10	27	+¼	*3 14 1
Eastern Tel. Ord.	Stock	10	10	270	+10	*3 14 1
Globe Tel. and T. Ord.	10	10	10	29½xd	+¾	*3 15 3
do. do. Pref.	10	6	6	11⅝	—	5 9 0
Great Northern Tel.	10	20	20	32½	+½	... ...
Indo-European	25	10	10	55½	—	*4 10 0
Marconi	10/-	5	*10	4⅜	+1/16	... ...
Marconi-Marine	1	8¾	19½	3¾xd	+⅛	4 12 4
Oriental Telephone Ord.	1	12	12	8	—	... ...
Western Telegraph	10	10	10	26¾xd	+1	3 14 8

*Interim.

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref. ...	5	5⅛	5½	8½	−⅛	7 9 3
do. do. 2nd Pref. ...	5	6	6	8½	−1/16	7 12 4
do. do. 5% Deb. ...	Stock	5	5	72½	−1½	6 18 0
British Electric Traction Def. Ord.	,,	—	—	850	−75	... ...
do. do. Pref. Ord.	,,	8	8	128	—	6 5 0
Brazil Traction ... ... * ...	100	6	7	61	−6	3 5 6
Brit. Columbia Elec. Rly. Pcc. ...	Stock	5	5	95½	−1	5 1 7
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	12/-	—	... ...
London United Tram Deb. ...	Stock	4	4	61	—	6 11 4
Mexico Trams, 5% Bonds	—	5	5	71½	−6	6 19 10
Mexican Light Common	100	Nil	Nil	80	—	... ...
do. 7% Pref.	100	Nil	7	70½	+1	9 3 0
do. 1st Bonds	—	5	5	79	—	6 6 7
Yorkshire (West Riding)	1	Nil	Nil	5/-	—	... ...

Manufacturing Companies.

Assoc. Elec. Ord.	1	—	—	33/-	—	... ...
Babcox & Wilcox	1	13	15	3-7/16	—	*4 7 3
British Aluminium Ord.	1	10	10	47/6	+1/16	*4 4 2
British Elec. Transformer Pref. ...	1	7	7	15/-	—	9 6 8
Br'tish Insulated Ord.	1	15	15	4½	—	3 3 3
Brush Ord.	1	10	10	27/6	—	7 5 6
Callenders	1	15	15	4⅜	+1/16	3 9 0
do. 6½% Pref.	1	6½	6½	1¼	—	5 4 0
Crompton Parkinson Ord.	5/-	—	—	1	—	... ...
do. 8% Pref.	1	—	8	25/-xd	—	6 8 0
Edison-Swan 1st Pref.	1	7½	7½	25/9	—	7 1 2
do. 5% Deb.	Stock	5	5	86½	—	5 15 7
Electric Construction	1	7½	7½	1	—	7 10 0
Enfield Cable Ord.	1	20	20	5xd	−¼	4 0 0
English Electric	1	Nil	Nil	7/6	−9d.	... ...
do. do. Pref.	1	3	Nil	9/6	—	... ...
Gen. Elec. Pref.	1	6½	6⅝	24/6	—	5 6 1
do. Ord.	1	7½	10	3	−7/6	3 6 8
Henley...	1	25	25	6	—	4 1 8
do. 4½% Pref.	5	4½	4½	1	—	5 6 0
India-Rubber	1	Nil	Nil	13/9	+¼	... ...
Johnson & Phillips	1	12½	10	1½	—	5 3 1
Siemens Ord.	1	7½	7½	1⅝	—	5 9 1
Telegraph Construction	12	10	10	25½	—	*4 14 3

* Dividends paid free of Income Tax.

Belgium's Foreign Electrical Trade.

Statistics for 1927 and 1928 Compared.

THE Belgian Government now publishes monthly statistics of the country's foreign trade in considerable detail, and with the publication of the December issue it is possible to survey the import and export trade in electrical machinery and apparatus during the past two years. Belgium's balance of trade in dynamo-electric machinery has changed. Whereas between 1926 and 1927 there was a decrease in imports and an increase in exports, the latter being the greater, the tendency last year altered, with the result that imports were the greater. The exports of telegraph and telephone apparatus are still increasing and the imports are comparatively small. There is a large quantity of unspecified electrical apparatus purchased abroad. Below are given the weights of electrical goods imported and exported in 1927 and 1928, with notes of increases or decreases :—

Imports.

	1927. Thous. kg.	1928. Thous. kg.	Inc. or dec. Thous. kg.
Dynamo-electric machines—			
Total	2,595	3,773	+1,178
From France	832	1,100	+ 268
,, Germany	655	1,059	+ 404
,, Sweden	221	524	+ 303
,, United States	116	64	− 52
,, Switzerland	318	432	+ 114
Dry batteries—			
Total	198	240	+ 42
From France	26	11	− 15
,, Denmark	93	134	+ 41
,, Germany	57	68	+ 11
Accumulators and plates—			
Total	213	320	+ 107
From United States	53	192	+ 139
,, Great Britain	17	—	− 17
,, France	28	59	+ 31
,, Germany	21	31	+ 10
Cables, submarine and underground—			
Total	491	536	+ 45
From Germany	393	136	− 257
,, Holland	46	354	+ 308
Insulated wire and cable, other—			
Total	435	552	+ 117
From Germany	303	347	+ 44
,, France	43	86	+ 43
,, Holland	33	23	− 10
Carbons for electrical purposes—			
Total	346	434	+ 88
From Germany	116	110	− 6
,, United States	148	237	+ 89
Insulators of porcelain, glass, &c.—			
Total	472	1,065	+ 593
From Germany	108	162	+ 54
,, France	324	837	+ 513
Insulating tubes, not metal covered—			
Total	13	36	+ 23
From Germany	7	31	+ 24
Insulating tubes, other, with junction boxes, &c.—			
Total	139	349	+ 210
From Germany	123	312	+ 189
Metal-filament lamps—			
Gas-filled (mainly from Holland)	37	65	+ 28
Vacuum, total	65	332	+ 267
From Germany	12	139	+ 127
,, Hungary	10	21	+ 11
,, Holland	36	150	+ 114
Wireless valves—			
Total (mainly from Holland)	5	16	+ 11
Measuring instruments and parts—			
Total	226	255	+ 29
From Germany	78	96	+ 18
,, France	39	46	+ 7
,, Switzerland	85	99	+ 14
Telegraph and telephone apparatus—			
Total	138	205	+ 67
From Germany	29	64	+ 35
,, France	49	58	+ 9
,, Great Britain	25	38	+ 13
Electrical and electro-technical apparatus and parts not elsewhere specified—			
Total	1,871	2,816	+ 945
From France	588	1,014	+ 426
,, Germany	662	908	+ 246
,, United States	158	228	+ 70
,, Holland	150	143	− 7
,, Great Britain	70	122	+ 52
,, Sweden	68	168	+ 100
,, Switzerland	140	210	+ 70

Exports.

Dynamo-electric machines—			
Total	3,064	2,600	− 464
To Belgian Congo	550	288	− 262
,, Argentina	139	132	− 7
,, Brazil	159	153	− 6
,, Great Britain	549	615	+ 66
,, Holland	213	565	+ 352
Dry batteries—			
Total	88	183	+ 95
To Holland	50	98	+ 48
,, Great Britain	32	81	+ 49
Accumulators and plates—			
Total	657	667	+ 10
To Belgian Congo	9	—	− 9
,, Argentina	288	264	− 24
,, Holland	46	104	+ 58
Insulators of porcelain, glass, &c.—			
Total	99	122	+ 23
To Belgian Congo	36	15	− 21
,, France	26	13	− 13
Cables, submarine and underground—			
Total	4,839	6,699	+1,860
To Belgian Congo	210	282	+ 72
,, Germany	696	1,067	+ 371
,, Argentina	*	649	—
,, Great Britain	1,470	2,757	+1,287
,, Holland	487	535	+ 48
Insulated wire and cable—			
Total	2,719	3,652	+ 933
To Germany	118	171	+ 53
,, Belgian Congo	114	42	− 72
,, Brazil	192	155	− 37
,, Great Britain	647	682	+ 35
,, Holland	342	480	+ 138
,, Argentina	35	*	—
Insulating tubes—			
Total	446	411	− 35
To Germany	4	19	+ 15
,, Egypt	167	196	+ 29
,, Greece	63	18	− 45
Metal filament lamps of all kinds—			
Total	75	99	+ 24
To Congo	3	—	− 3
,, Great Britain	21	10	− 11
Measuring instruments and parts—			
Total	27	34	+ 7
Telegraph and telephone apparatus—			
Total	2,585	2,654	+ 69
To China	33	*	—
,, Spain	123	19	− 104
,, Australia	99	*	—
,, France	75	819	+ 744
,, Italy	89	86	− 3
,, Norway	72	*	—
,, Holland	91	177	+ 86
,, Switzerland	64	*	—
,, New Zealand	89	57	− 32
,, Mexico	480	512	+ 32
Electrical and electro-technical apparatus and parts not elsewhere specified—			
Total	966	1,202	+ 236
To Belgian Congo	40	240	+ 200
,, Germany	46	12	− 34
,, Egypt	165	39	− 126
,, France	80	135	+ 55
,, Holland	78	201	+ 123
,, Syria	28	*	—
,, Siam	44	*	—
,, Great Britain	9	*	—

* Not specified.

Cadmium Electrodeposition.

One of the most important of the recent developments in the electro-plating industry is the use of cadmium, primarily as a rust preventive of ferrous material, the increasing application of the deposit indicating that it is generally considered to fulfil its function satisfactorily.

By S. WERNICK, M.Sc.

(Extracts from a Paper read before the Electroplaters' and Depositors' Technical Society.)

THERE has been marked divergence of opinion as to the efficiency of cadmium as a rust preventive, particularly as compared with zinc. Cadmium deposits may, however, differ widely in their physical properties, which largely affect their protective capacity, and it is probable that statements which are apparently contradictory might often have been rendered compatible were such details as the composition of the solution used, conditions of deposition, and thickness of the deposit indicated in each case. Assuming the use of reasonably homogeneous and non-porous base metal, effective preparation of the material before plating, &c., are postulated, then the protective capacity of the resultant plating will depend largely upon the fineness of the deposit (which is intimately bound up with the composition of the solution, and the electrical, mechanical, and thermal conditions employed in plating), the amount of cadmium deposited per unit area (*i.e.*, the thickness of the deposit) and the distribution of the deposit over the cathode area (which depends largely on the throwing power of the solution).

Composition of Solutions.—The composition of cadmium plating solutions recommended by different authorities diverge widely, and there can be little doubt that they must be productive of deposits possessing fundamentally different characteristics. Most cadmium solutions have an inherent tendency to alter in composition, tending, with few exceptions, to "build up" their metal content and reduce the free cyanide concentration, so that there is, in addition, progressive variation in the characteristics of the deposit as the solution ages. Apart from this, the inconvenience and cost of managing such a solution is an important item to the plater.

The ideal stabilised solution is one in which the anode and cathode current efficiencies are each 100 per cent. The anode efficiency of the average cadmium solution exceeds the cathode efficiency appreciably; the excess may be as high as 25 per cent., *i.e.*, the electrode efficiency ratio may reach 1.25. The ratio may be decreased by using insoluble anodes, as well as cadmium anodes, in the same solution. The effect of decreasing the effective cadmium area upon the electrode efficiency ratio is shown below in the case of one solution, the area of anode and cathode being identical:—

Per cent. insoluble anode area.	Electrode efficiency ratio.
0	1.21
50	1.07
75	1.04

The effect is due to a reduction in the overall anode c.d., although the reduction is by no means in proportion to the ratio of soluble anode area. This method of stabilising the cadmium solution is widely used; it appears to be fairly effective, though not ideal. In practice, there is a progressive change in the ratio soluble/insoluble anode area due to the gradual solution of the cadmium. Usually the "insoluble" anode is steel, but to a small extent it is soluble, and introduces an undesirable ingredient into the solution. It has also been stated that it decomposes the ingredients of the solution, although others attribute a beneficial effect, suggesting that the tendency to build up carbonate in solution is lessened.

A study of the effect of the concentration of the principal constituents of the solution upon the electrode efficiency ratio undertaken by the author yielded the results outlined below.

(*i*) The cadmium content may vary from about 5 to over 30 grams per litre. Satisfactory deposits are obtainable at the lower concentrations and considerations of economy in the case of such an expensive metal as cadmium have often led to their adoption. However, a progressive decrease in the electrode efficiency ratio occurs with increase in cadmium content, being appreciable even with double the lower limit quoted above, and approaching unity at about 30 grams per litre. At the same time, there is a marked rise in the conductivity of the solution, amounting to almost twice its original value at this figure. Deposits having a very fine crystal structure are obtainable with a cadmium content in excess of 30 gm. Due to deficiency in free cyanide, "fouling" of the anode occurred with solutions of low cadmium concentration, but to a decreasing extent with increase in the cadmium content, the anode remaining clean (except for a natural darkening) when the cadmium content reached 25 gm. and over.

(*ii*) Free cyanide is another constituent which varies widely; from 6 to 60 grams per litre has been recommended. It is stated to have a very pronounced effect on the solution of the anode, but, using a solution having a cadmium content of approximately 30 gm., upon which figure the free cyanide is calculated as percentage (not as per cent. present in solution), increasing the free cyanide content increased only very slightly the electrode efficiency ratio, even when the concentration reached 125 per cent. At higher concentrations, however, there is a marked increase in the electrode efficiency ratio. Free cyanide must, therefore, be rigorously controlled at higher concentrations, excess beyond a given limit resulting in rapid building up in metal content. It is possible that at certain concentrations of cyanide polarisation of the anode may occur.

The conductivity of the solution very pronouncedly increases with progressive increase of free cyanide. Quite a substantial increase is, however, attained with a content of about 100 per cent., and although better conductivity is obtainable with more cyanide, that is a safe figure to maintain. The effect of increasing the free cyanide content upon the deposit is distinctly noticeable, there being a marked reduction in the grain size, the deposit also becoming white in colour. A further drawback of a high free cyanide content is the increase in gassing which results, particularly in the early stages of deposition, possibly due to the higher hydrogen over-voltage on cadmium, as compared with iron, causing the gas evolution to slacken and eventually cease almost entirely when the cathode is well covered with cadmium. The anode corrosion obtainable, with resultant cleanliness of anode surface, is quite efficient in solutions of comparatively low free cyanide content.

(*iii*) The alkali constituent is usually added as a means of increasing the conductivity of the solution; it is not essential, being completely omitted from some formulæ. Experiment has, however, indicated that the presence of a caustic alkali is of definite value, having a marked tendency to bring the electrode efficiency ratio nearer to unity. It is possible, too, by its use to standardise the alkalinity of the solution. The ratio decreased progressively as the alkali content (caustic soda was employed) was increased from 1.5 to 30 gm. per litre, but, contrary to expectation, the conductivity was not appreciably affected. The free cyanide content of the solution used was 56 per cent., calculated on the combined cyanide present. The addition of the caustic soda also had a markedly beneficial effect on the deposit, the grain size of which was progressively reduced, becoming "structureless" at the upper limit, and the colour decidedly whiter. The tendency towards streaking and patchiness at the cathode that occurrs occasionally also ceased when caustic soda was present. There is little gassing at the anode, which is rendered a dark-grey colour, remains unfouled, and is uniformly corroded. Slight gassing occurred at the cathode only with the highest caustic soda concentration.

To summarise, the conditions best suited to the attainment of a deposit of small grain size, a solution of optimum conductivity, and a solution of maximum stability, *i.e.*, having an electrode efficiency ratio as near as possible to unity, appear to be as follows:—

(*a*) For metal content a relatively high concentration is best; a 30 gm. per litre cadmium content gives good results.

(*b*) Free cyanide may vary within fairly wide limits, about 100 per cent. (over the combined cyanide content) giving most favourable results; appreciable excess beyond this figure markedly affects the stability of the solution.

(*c*) Caustic alkali is a desirable constituent; from 15 to 30 gm. per litre is a useful range, the upper limit giving superior results.

(*d*) High temperatures of the solution are best avoided.

(*e*) C.d. of from 10 to 15 amps. per sq. ft. gives best results.

A solution made up on these lines yielded an electrode efficiency ratio slightly in excess of unity and high conductivity, the deposit being "structureless" and the condition of the anode satisfactory.

Protective Properties.—The superior corrosion resistance of a cadmium deposit, as compared with zinc, is undoubtedly largely due to its lesser chemical reactivity. It is the ideal protective agent for ferrous material in so far as it is nearest to it on the anodic side of the electrochemical series, whereas the p.d. between zinc and iron is quite appreciable. While, therefore, the intrinsic protection afforded by zinc is higher than that which cadmium can give, due to its greater solution pressure, its rate of preferential, or sacrificial, corrosion is also higher for the same reason, and a smaller amount of cadmium, or a thinner deposit, provides the protection afforded by a comparatively thick zinc deposit.

Thicker cadmium deposits give appreciably better protection: a deposit 0.4 mil. thick, for example, compared with 0.3 mil., provides protection considerably in excess of the ratio of the thicknesses. For efficient protection, a thickness of 0.4 mil. is a desirable standard to adopt in commercial work, and it is suggested that the more generally advocated 0.2-mil. deposit be reserved for precision work, &c., when the thicker deposit cannot be entertained.

Composite Deposits.—Cadmium plating as an under-coating for more pleasing finishes of less protective capacity is in use commercially. Nickel is far more readily deposited upon a cadmium surface than upon zinc, but the composite deposit is quite inferior to cadmium alone as a corrosion preventive. The cadmium must continue to function as a protective by virtue of its own sacrificial corrosion, or the very purpose for which it was applied would be defeated. At pores in the nickel, or other superposed finish, the cadmium accordingly reacts with the corrosive elements to form a cadmium corrosion product. The first stage in the corrosion of the composite plating is the appearance of a white salt at the weakest points in the nickel surface, at the centre of which, after the cadmium is totally "sacrificed," rusting of the underlying ferrous metal invariably occurs. Before rusting, the material presents a decidedly unsightly appearance. In the case of a superposed enamel finish, the same white corrosion product appears, causing the enamel to flake away, probably because of the increased volume occupied by the cadmium salt. The

Fig. 1.—50-ton Electric Locomotive.

thickness of the superposed nickel plating is an important factor in prolonging the time before corrosion occurs, due to a reduction of porosity, but since this remedy rests upon the efficiency with which the exposure of the cadmium to the atmosphere is prevented, it is obviously of negative value. Underlaying nickel with copper showed little, or no, improvement, while heat treatment of the cadmium after deposition was similarly ineffective. To sum up, while the composite cadmium-nickel deposit is superior in its protective capacity to nickel alone, its protection is considerably less than that of a cadmium deposit alone.

Mechanical Properties.—Mechanical defects of the deposit have a marked effect upon its protective capacity. Cadmium deposits are particularly prone to blistering, to avoid which it is important to ensure a chemically clean surface and also that cathodic gassing is at a minimum.

Relatively high c.d. and elimination of preliminary "flashing" favour the ultimate development of blistering. In the case of composite cadmium-nickel deposits, G. B. Hogaboom suggests that blistering may be due to the oxidation of the underlying cadmium. The adhesion of a good cadmium deposit is of a high order; comparatively thick cadmium deposits show considerable flexibility and perfect adhesion in twisting, bending, and coiling tests, when applied to wire as thin as 0.25 in. in diameter. Although cadmium ordinarily becomes embrittled at 100 deg. C., nevertheless the deposited cadmium does not appear to be greatly affected when subjected to subsequent heat-treatment at that temperature, at least in so far as its flexibility is concerned.

The composite cadmium-nickel deposit subjected to these tests showed a marked decrease in flexibility, as well as an increase in brittleness, probably depending to a great extent on the hardness of the deposited nickel. Although no signs of parting of the composite plating occurred in the case of plated sheets under a cupping test, flaking readily occurred when the cadmium-nickel was applied to wires, both in twisting and coiling tests, although it showed up well in the bending test. The quality of the nickel deposit is largely the determining factor, since the cadmium undercoat appears to remain little affected.

Discussion.

The chairman, Dr. G. D. Bengough, said this paper alone was worth about 5 years' subscription to the Society. There was a great field for cadmium plating for resisting alkalies and ammonium chloride, which presented big problems in industry. The author's defence of the salt-spray test for metal coatings was reasonable; it had its practical uses, but must not be used too widely, and only for comparative purposes.

Mr. E. A. Ollard said the author had shown that cadmium could be definitely superior to zinc if care was taken in its deposition. Often a finer deposit was obtained in a barrel vat than in a still vat; addition agents were necessary in the latter. Yellow dextrin gave good results. Could not anode solubility be overcome by reducing the anode area? The salt-spray test was not representative of outdoor exposure.

Mr. S. E. Weill said that cadmium was really more plentiful than was thought, but prices were kept up. Cadmium was a fairly simple metal to deposit, though, of course, the quality was important. Although cadmium was as good, if not better than zinc, as a rustproofing material, it was no good at all as an undercoat. Nickel and enamel above cadmium gave way in 6 months.

Mr. G. E. Gardam said that the ferroxyl test showed no reaction with iron when in contact with cadmium, even when large areas were exposed. Owing to the high atomic weight of cadmium, it was deposited much more rapidly than zinc; it was, however, soft.

Mr. A. E. Boulter said that sometimes the cadmium deposit was patchy, showing shades of white and yellow. What available supplies of cadmium were there?

Mr. L. Goring, with regard to the composite coat, found it advantageous to put nickel under cadmium and then overlay it with nickel again. It was very important to wash thoroughly owing to a tendency to spotting out; dilute acids were useful. The character of the deposit often varied with the addition agent used, there being different degrees of whiteness. If caustic soda were used in the solution, it was best to use the solution cold.

The author then replied to the discussion.

Railway Electrification in New Zealand.

The Main-line scheme from Christchurch to Lyttleton was officially opened recently.

THE official opening took place recently of the electrified main railway line in New Zealand from Christchurch to Lyttleton. The line includes the Lyttleton tunnel, through which passes the whole of the traffic between the north and south islands. The contract for the work was awarded to the English Electric Co., Ltd., and, in common with other similar contracts, it included electric rolling stock, the sub-stations and the track equipment.

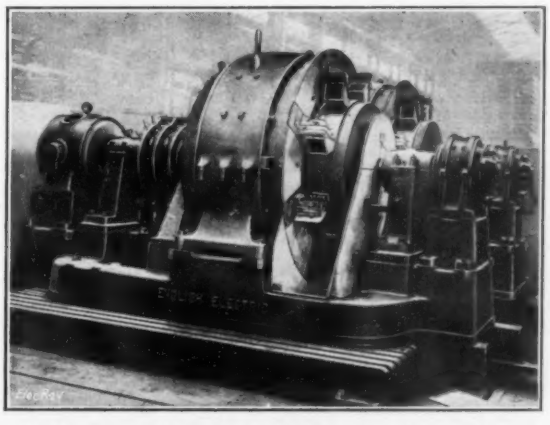


Fig. 2.—1,350-kW, 1,500-V Rotary Convertor.

The system adopted is 1,500-V d.c., with overhead collection, and the principal items of the contract were six 50-ton locomotives, fig. 1, with camshaft control, two 1,350-kW, 1,500-V rotary convertors, fig. 2, complete automatic and supervisory switching equipments for these machines, and the structures and all material for the overhead line.

Ministers of the New Zealand Government and representatives of the departments concerned expressed their complete satisfaction at the record time achievement in the running of the first train. The rotary-convertor plant and the automatic switching equipments functioned perfectly. The rotary convertors are of the "English Electric," single-armature type, and it is understood that on test six short-circuits were successfully cleared on the d.c. line, and that both convertors continued to work satisfactorily through two heavy surges on the 11,000-V supply.

It may be recalled that a few years ago the same company carried out the electrification of the Arthur's Pass tunnel section of the New Zealand Government Railways, and furnished, in addition to a complete power-station installation, the overhead line with feeders and cables, the tunnel lighting and six locomotives.

The Institute of Metals.

An account of the meetings and social functions held in London in celebration of the coming-of-age of the Institute.

At the twenty-first annual general meeting of the Institute in London on March 13th and 14th, Dr. W. Rosenhain, president, who was re-elected, presented the report of the Council for the year 1928-29, which indicated that the membership had grown in 20 years from 355 (on December 31st, 1908) to 2,003; last year's increase was 100 members. The fact that the Institute has gained in such a comparatively short space of time world-wide recognition in its particular sphere of metallurgy is an indication that it enters its third decade with every prospect of increased usefulness to the sciences and industries that it serves.

The opportunities of service to members were increased in many ways during the past year, notably as a result of the large extension in the library and office accommodation. A still more important development has been envisaged recently by the Council: the proposal has been made that the Institute should co-operate in a scheme which has for its object the securing of a suitable site and building to accommodate a number of institutions and societies having somewhat similar aims, so as to secure economy by co-operation in certain services and by the use of a common meeting-hall, library, and committee rooms. The sudden expansion of premises resulted in the surplus of income (£150) over expenditure (£7,591) being somewhat small, but invested funds have been increased to £4,986. The six British local centres continue their excellent work, and the growing overseas membership is now one-third of the total; the *Journal* is regularly purchased by 162 public libraries and institutions in 23 countries.

Autumn Meeting.

The Council has in hand arrangements for the next autumn meeting, to be held in Dusseldorf, Germany, from September 9th-12th, 1929, by the invitation of the Verein Deutscher Ingenieure and of the Deutsche Gesellschaft fur Metallkunde. Steps are also being taken in connection with the visit of the Institute to America in 1932.

Exhibition.

Dr. W. Rosenhain was presented with a bronze plaque as a "twenty-first birthday" gift, and in the evening presided at the dinner at the Trocadero Restaurant.

On the next evening a conversazione took place at the Science Museum, South Kensington. The president and Mrs. Rosenhain received the guests, refreshments were served, and a selection of music was electrically amplified and reproduced by loud-speaker from "H.M.V." gramophone records. A metallurgical exhibition, which consisted of 20 separate displays, proved to be of considerable interest; amongst the exhibitors were:—

British Aluminium Co., Ltd.—Set of articles covered by the anodic process as used on airships; various types of joints used on steel-core aluminium overhead conductors; bare conductor after 11 years in an industrial atmosphere and busbar subjected to salt spray for a fortnight; joints between aluminium overhead lines and house-service leads; aluminium winding of traction motor with oxide insulation; methods of soldering and welding aluminium kettle spouts.

Bureau of Information on Nickel, Ltd.—A nickel-iron storage battery illustrated one of the many different applications of nickel itself, an application which makes use of the high electrical conductivity of pure nickel used in the form of extremely thin flakes which are produced by electro-deposition on copper and the subsequent dissolving of the latter metal.

Chemical Research Laboratory, Teddington (Dr. W. H. F. Vernon).—Atmospheric tarnishing and corrosion of metals: in the case of copper the formation of protective oxide films, either so thin as to be practically invisible or sufficently thick to refract light and hence give rise to characteristic interference ("temper") colours was illustrated, as was also the existence of a critical film-thickness (within the "invisible" range) below which protection against tarnishing is no longer afforded; whereas a film of oxide is protective, a film of sulphide actually promotes further oxidation.

Corrosion Research Committee (R. May, A.R.S.M., investigator).—Jet test apparatus for testing samples of condenser tubes for resistance to impingement of sea water.

Mr. S. Cowper-Coles.—Specimens with photomicrographs of electrolytic copper deposited under varying conditions.

Dr. C. F. Elam (Mrs. Tipper).—The application of X-rays to the study of metals, and examples of alloy crystals.

National Physical Laboratory.—Pure metals and elements and electric furnaces.

W. G. Pye and Sons.—X-ray photogoniometer.

Sir John Cass Technical Institute.—Apparatus for electrogravimetric and potentio-titrimetric chemical analysis.

Synopses of Papers.

Amongst the papers presented and discussed at the March meetings were the following:—

Refining Kettles.—Mr. H. C. Lancaster dealt with "The Importance of Design, and Setting of Large Kettles Used for Refining and Low-melting-point Alloys."

In the subsequent discussion Mr. D. F. CAMPBELL said that quite recently he had had to consider the problem in connection with a works in Algiers at which cables were to be manufactured, and also in connection with another works in France. The problem of heating them by means of electricity was being studied; in that case the temperature of the source of heat was very much lower than flame temperature, and in consequence there was less strain on the metal than when a flame was used. Was there any possibility of the adoption of electric heating, in spite of the higher cost, bearing in mind that with electricity one could secure even heating, and the temperature of the source of heat was probably about 1,000 deg. maximum, whereas flame temperature was very much higher? Further, the electrical method lent itself very well to the provision of suitable arrangements for supporting the pots, and one could absolutely control the temperature; the latter was a very important factor in connection with lead in cables.

The PRESIDENT suggested the use of electrical immersion heaters. The temperatures involved were not very high, and it would not be difficult to construct a heater which could be immersed in the molten metal, so that the whole of the heat would be generated within the metal and would not have to pass through the pots. It appeared that that would relieve considerably the duty to which the pots were exposed.

Mr. A. H. MUNDEY said that the immersion-heater principle was adopted quite considerably in the trade in which he was interested.

Battery Zinc.—In a paper on "The Solution of Plain and Amalgamated Zincs in Electric Batteries," Mr. J. NEWTON FRIEND, D.Sc., Ph.D., showed that for use in electric batteries with dilute sulphuric acid, or with saturated ammonium-chloride solutions, plan high-grade 99.9 per cent. zinc could not satisfactorily replace the amalgamated metal; neither was there any material advantage in using amalgamated pure zinc instead of amalgamated ordinary commercial 98 to 99 per cent. zinc.

Electro-deposits on Aluminium.—Mr. G. B. BROOK and Mr. G. H. STOTT, B.Sc., outlined in "Note on the Testing of Electro-Deposits on Aluminium" investigations carried out during the past year on a considerable number of samples of commercial electroplating on aluminium. Most of them were finished in nickel as being the commonest metal used for securing a finish in general commercial practice. This contribution was not concerned with the actual plating of the material, but confined to the development of a test, or tests, which would indicate the stability of the deposit from the user's, rather than from the producer's standpoint.

Electric Furnaces.

Amongst the papers submitted and discussed were two (one of which is referred to below) relative to the use of electricity for industrial heating purposes.

Dr. W. ROSENHAIN, F.R.S., and Mr. W. E. PRYTHERCH, M.Sc., of the National Physical Laboratory, described an improved form of electric resistance furnace for which advantages are claimed with regard to higher available working temperatures (up to 1,400 deg. C.), durability, and freedom from oxidation of the carbon resistor. The heating element of this type of furnace consists of carbon or graphite pellets, or short rods placed end to end, in a refractory sheathing tube which fits easily over them. Heating occurs by contact resistance,

and the sheathing tube prevents the access of air sufficiently to avoid any appreciable burning of the carbon.

In the subsequent discussion, Dr. MAX HAAS, after emphasising the need for a laboratory furnace for use at high temperatures, asked if it were possible to use a furnace of 5, 8, or 10 cm. diameter of the type mentioned by the authors for the purpose of heating a crucible to 1,500 deg. C.

Mr. A. GLYNNE LOBLEY, referring to the authors' statement that no actual measurements of change of resistance with time had been carried out (up to the time the paper was written), asked if figures had been obtained since. That matter was of extreme importance, because, if there were changes of resistance in one part as distinct from another, hot spots would occur.

Mr. A. B. WINTERBOTTOM said that his firm had been interested in the carbon-contact resistance when Dr. Rosenhain first described it. They made an electric fire with a carborundum glow bar in a parabolic reflector, but had wanted something with a longer life and were attracted by the possibilities of making a variable-load heater. They had made some heaters on the same principle, using vitreosil tubes with small carbon pellets 1/32 in. long and of about ¼ in. in diameter; with 400 of them in a tube they had got about 100 volts across without getting too large a current, and had got it operating at temperatures from 900 to 1,200 deg. C. Had the authors experience of different qualities of carbon? He had used a sort of arc carbon and it had stuck together for some time; afterwards he had used a plain carbon, and it did not appear to have suffered any change at all.

Mr. W. B. CLARKE referred to some granular-carbon resistance furnaces with which he had been concerned, which reached extremely high temperatures. He gathered that the furnace described by the authors was not intended to reach extreme temperatures. What was the difference between the alternating- and direct-current effects on the resistance of the pellets in the furnace He imagined there would be a considerable difference between the two.

Dr. W. ROSENHAIN, president, replied to the discussion. With regard to the remark that the furnace was not intended to reach the extreme temperatures which could be obtained in electric carbon-resistance furnaces, he said there were two other requirements for that: one was permanence of the resistor material, and the second was the absence of anything more than traces of carbon-bearing gases in the furnace atmosphere. One of the fundamental differences between a furnace of that type and the granular-carbon resistance furnace was that the resistor in the former was, relatively speaking, permanent; in that connection he spoke conservatively, because the authors had not yet discovered the length of run of which one of those resistances was capable. Oxidation was so slow that after hundreds of hours running at temperatures round about 1,300 deg. C. one could not see any appreciable effect upon the appearance of the pellets when they were removed from the carbon sheet. The reason was interesting; it was not necessary to attempt to make the sheet gas tight, or to have any gas-tight fitting between the resister and the sheet. There was a capillary air space to begin with, and later on a space filled with gases in equilibrium with the hot carbon, and that was quite sufficient to act as a protection from the external atmosphere. The viscosity of carbon dioxide at high temperature was very high, and the rate of diffusion was, therefore, quite slow. The consequence was that the capillary space acted as a perfectly satisfactory seal for that purpose, and left the resistor pellets and electrodes at the ends free to move and maintain contact. The authors would not attempt, and did not recommend, any method of varying the pressure for regulating the temperature of such a furnace; any attempt to regulate by that means resulted, in his experience, in irregularity. One could increase the pressure, but could not decrease it again uniformly throughout the column, and there resulted uneven contact pressures and hot spots. They worked with a constant pressure. He ventured to say that the limit of time, or temperature, at which the furnace could be used depended upon the refractory material of which the sheet was made. The authors had used a German product ("Pythagoras" porcelain), which was very satisfactory up to a certain point, but it would certainly not withstand temperatures as high as 1,500 deg. C. It would stand very high temperatures for a long time, provided it was well supported, but he considered 1,400 deg. C. was quite the upper limit. On the other hand, it was not impossible to make special refractories for this purpose which would stand much higher temperatures, and some of his colleagues were engaged on that work, but he did not think they would be able to exceed temperatures of about 1,800 deg. C. at reasonable cost yet; at the moment, that temperature had not been reached. He could not give data about the change of resistance with time, but might be able to do so when the discussion was printed in the Institute's *Proceedings*.

(*To be continued.*)

Boiler Feed-water Circuits.

Modifications of the working-fluid cycle that are calculated to raise the thermal efficiency of steam power stations.

By J. G. WEIR, C.M.G.

(*Abstract of a Paper read before the* INSTITUTION OF MECHANICAL ENGINEERS.)

THE fundamental cycle traversed by the working fluid in all steam-power installations is from boiler to power generator, from power generator to condenser, and from condenser back to boiler. Superimposed on this simple circuit there are generally a number of subsidiary heat exchanges.

The closed-feed system naturally depends for its success as a preventative of corrosion on the efficiency of the condenser as a de-aerator. Feed-water can be de-aerated if the water be boiled, and this can be done at any pressure and temperature. The first apparatus to make use of this fact was the "Weir" direct-contact heater. This heater works in conjunction with a simple type of open-feed system; the simplest form of this type of installation is that used on the majority of steamships, in which the feed-water is passed from the open feed tank through a spray valve into a chamber where it mixes with exhaust steam. The pressure in the chamber is maintained close to the equivalent boiling point of the mixture by a small connection to the condenser, through which the liberated air is withdrawn. A water level is maintained in the base of the chamber by means of a float which, in the case of water-tube boilers, controls the delivery of water from the feed tank into the chamber.

In order to increase the thermal efficiency of any practical feed cycle, various arrangements of feed-heaters may be incorporated. A common arrangement has one stage of exhaust-steam heating and two stages of bled-steam heating. By selecting the correct number and kinds of auxiliaries to be steam driven, the quantity of auxiliary exhaust can be arranged to give an outlet feed temperature from this heater of about 160 deg. F. to 170 deg. F.

Another important influence on the feed circuit is the make-up water, which is generally supplied by the evaporation of raw water at a suitable pressure datum. The correct pressure datum to employ depends upon the particular circumstances of the lay-out. It is, however, generally preferable to have the datum low down on the temperature-pressure curve. This is advantageous, primarily because of the soft scale which results from low-temperature evaporation and from the relatively larger temperature differences at the low end of the scale. This may be seen by considering the comparative temperature differences at, say, 100 lb. per sq. in. gauge steam pressure and, say, 5 in. vacuum; for a 5 lb. per sq. in. pressure difference in each case the comparative temperature differences are 11 deg. F. and 24 deg. F. This means that for the same transmission rate in each case the low-pressure evaporator need only have a surface 11/24th of that of the high-pressure evaporator; owing to the smaller transmission rate normally obtainable at low pressures this is not strictly true, but even when the lower transmission rate is allowed for, the surface reduction permissible is very considerable. It is occasionally found when working out heat balances that too much exhaust steam is available; in such cases the multiple-effect exaporator is advantageous. This evaporator may be double-, triple-, or quadruple-, or even sextuple-effect, the last two mentioned being primarily suited for the higher steam pressures. The ratio of production to steam used from the multiple-effect evaporator is approximately as follows: simple effect, 0.8 to 1; double effect, 1.3 to 1; triple effect, 2.6 to 1; and sextuple effect, 4 to 1. It is, however, only rarely that anything more than double effect is necessary for normal power plant.

Wide fluctuations in load adversely affect the performance of a boiler plant, and for this reason various forms of heat accumulators have been devised for insertion in the feed circuit. The principle involved is that of storing heat in a large quantity of water, under pressure and at saturation temperature, and releasing that energy in the form of steam under decreasing pressure. A Ruths steam accumulator may be arranged in the normal feed circuit of an industrial plant, where a proportion of the steam is used for electrical generation and the remainder for process work.

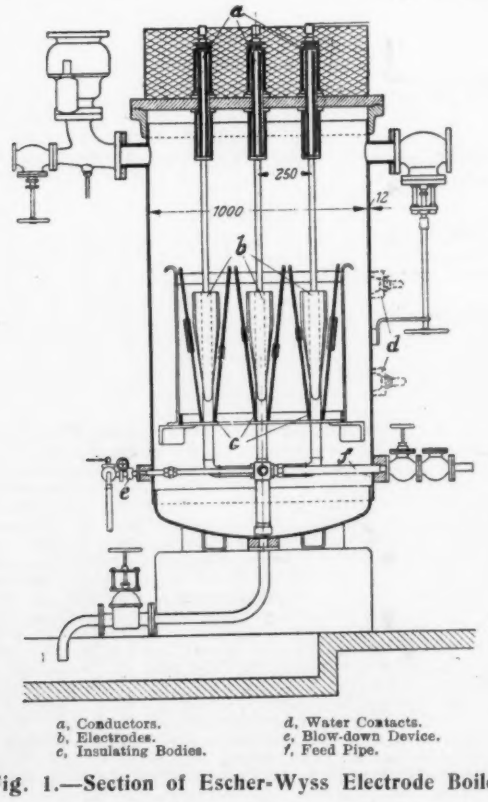
The use of boilers at two pressures in a combined circuit has recently become fairly common, and in this way it is possible to modernise plant by superimposing high-pressure boilers cascading into the system. To obtain the full thermal advantage of polytropic steam generation, it is necessary to put the boilers in series on the flue-gas side. The high-pressure boilers are preferably of the water-tube type and the low-pressure boilers of the capacity type. An interesting arrangement has two water-tube and one capacity-type boilers arranged for polytropic steam generation. On both steam and flue-gas sides the boilers are arranged in series. With this arrangement no air preheaters are required, as the low-pressure boiler will reduce the flue-gas temperature to the same level as in a normal air preheater. Similarly, no economisers are required, but single-stage regenerative feed-heating can, if desired, be incorporated in the system. The feed-water for the intermediate- and high-pressure boilers is taken from the low-pressure and intermediate-pressure boilers, respectively. The low-pressure boiler is fed in the normal manner with condensate. The arrangement of boilers in series at varying datum is an alternative to the more common scheme incorporating a single high-pressure boiler with air preheater, economiser, and multiple-stage feed-water heating.

When the fundamental conditions of maximum efficiency in a steam cycle are investigated, it is clear that steam is not entirely suitable as a working fluid. Various alternatives have been tried, the most successful being the superimposing of a mercury circuit on a steam circuit. The binary-fluid system has already been tried with a mercury turbine developing 1,200 kW, with results sufficiently encouraging to warrant the construction of a larger set of 20,000 kW, which consists of a 10,000-kW mercury turbine and a 10,000-kW steam-turbine, and is estimated to have an overall thermal efficiency of 32.5 per cent., which compares favourably with the best Diesel performance. It is claimed that a modern steam station with a boiler pressure of 350 lb. per sq. in. can have its thermal efficiency increased by 50 per cent. by the addition of a mercury-vapour installation.

Electric Steam Generation.

Some Details of the Escher-Wyss Plant Installed at the Padalarang Paper Mill in Java.

With the development of water-power resources corresponding quantities of surplus energy not infrequently become available, either because the new power stations cannot fully dispose of their total output for some time to come, or because energy is only required at certain times of the day or year. Within recent years so-called "waste" energy has been increasingly utilised for heating purposes in a number of industries, including raising steam. A case in point is the Padalarang paper mill in Java, which is located near a State-owned power station whose output is utilised only during the main lighting period, *i.e.*, from 6 to 9 p.m.; during the remainder of the day and for the greater part of the year from 500 to 3,000 kW are available, which is utilised in the paper mill for steam production by means of a plant installed by the Escher-Wyss Co., of Zurich.



a, Conductors. *b*, Electrodes. *c*, Insulating Bodies. *d*, Water Contacts. *e*, Blow-down Device. *f*, Feed Pipe.

Fig. 1.—Section of Escher-Wyss Electrode Boiler.

The steam is chiefly required for the digester plant, from 880 to 4,400 lb. per hour at 85 lb. sq. in. pressure, and for the paper-making machine, from 880 to 3,950 lb. per hour at 36 lb. per sq. in. pressure. The existing oil-fired plant consists of two Lancashire boilers, each of 965 sq. ft. heating surface and 115 lb. per sq. in. operating pressure. The two principal places of consumption are 430 ft. apart, so that it was decided to erect two sets of plant in order to avoid so far as possible radiation losses in the piping. One plant has been erected in the existing boiler house near the digester plant, the other being located adjacent to the paper machine; both are interconnected by means of an existing steam pipe.

In the boiler house the steam produced in the electrode boiler is admitted to the lowest point of the water chamber in the two Lancashire boilers, and thence conducted through the existing piping to the points where it is utilised, an arrangement which allows the Lancashire boilers to be used as heat accumulators to compensate for the considerable fluctuations in the steam consumption of the digester plant. At the same time the boilers are always under pressure, and may therefore, in case of a breakdown of the electrical plant, be brought into action within a few minutes, equivalent to the time required for starting up the oil-burners.

At least one of the boilers has to be put into service every evening between 6 and 9 p.m., when no energy is available. This daily service of three hours with oil firing prevents the complete cooling of the masonry, and the heat losses of the two boilers when serving as accumulators are therefore very small. Contrary to the digester plant, the steam consumption of the paper machine for a certain quality of paper is constant, and on no account may the steam supply fail: to avoid this with the electric boiler plant a separate accumulator boiler was erected to receive during short stoppages of the paper machine the excess steam, it being capable of giving off 5,500 lb. of steam at from 114 to 36 lb. per sq. in. pressure over a period of 1¼ hours, *i.e.*, an interval of time which suffices to repair a breakdown, or to start the spare boilers. The electrode and accumulator boilers have been erected in a separate room in the immediate vicinity of the paper machine, the valves of the steam distributor being controlled from the machine room, in which also the gauges for the two boilers are fixed.

Since the digester plant and the paper machine have the same maximum steam consumptions, it was possible to provide two boilers of equal size, which relieves the spare-part problem. The boilers are equipped with stationary electrodes fixed to the removable cover. The conductors which pass through the latter have no stuffing boxes, but automatically seal themselves by reason of the internal pressure. The principle of utilising the water in the electrode boilers as the heating resistance has been developed to the extent that the output of the boiler can be varied by altering the depth of immersion of the electrodes. A safety device prevents the live electrodes protruding above the water level, which, at 6,000 volts, would give rise to arcing. The main circuit breaker is operated by means of a contact in the circuit of the no-voltage coil so soon as the water level in the boiler drops below a certain point; the pump is also automatically switched off when the main circuit breaker operates, or in the event of the water level becoming too high. The supervision of the electrode boiler is very simple, being confined to a brief inspection every one or two hours by *personnel* employed on other work.

To compensate for the fluctuations of the steam consumption in the digester plant, the two Lancashire boilers are used as buffers. The steam produced by the electrode boiler is led to the lowest point of the water chambers of the boilers. The escaping steam condenses and gives off its heat to the water, the steam being extracted at the dome.

Domestic Electrical Developments.

New Cooking, Heating, and Cleaning Devices for use in the Home.

Domestic Appliances in Schools.

During the past few years Barnsley Corporation has launched general schemes for the development of the use of electricity for domestic purposes, including the hiring of electric cookers and hire-purchase of electrical domestic apparatus. A hired-wiring scheme for the supply of electricity to cottage property has also been introduced. In connection with the propaganda regarding the use of electrical domestic apparatus, the domestic centres of eight local elementary schools have been equipped with a total of 12 electric cookers, 15 electric wash boilers, and 130 electric irons, and the scholars receive instruction in the uses of the equipment.

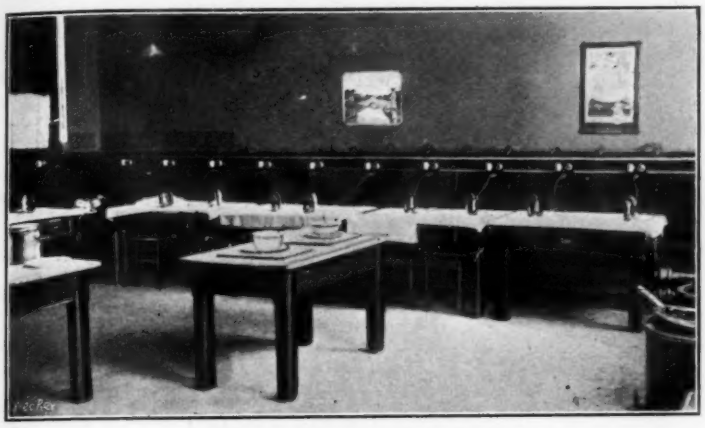


Fig. 1.—Electric Ironing Section.

The following are extracts from a report by the Barnsley education authorities on the result of the electrical equipment of the elementary school domestic centres:—

In effecting the reorganisation of elementary schools on the lines of the Hadow Report, Barnsley Education Committee made a determined and successful effort to overcome all obstacles that would hinder or delay the full operation of the scheme, and after providing new buildings or adapting existing buildings to the requirements of the "New Prospect," it gave its most careful attention to the provision of facilities for practical instruction in post-primary departments. The subjects of instruction are not vocational in the narrow sense of the word, but are treated in such a manner as to bring them into direct relationship with the facts of daily life, and the industrial interests of the town. The centres have been equipped with electrical apparatus, and the schemes of work have been so designed that the average girl, who is the home-maker of the future, will leave school with more skilled knowledge and a more intelligent grasp of the essentials of the ideals and standards of effective and successful house management than she could possibly obtain under the former arrangement. The domestic science rooms have been transformed into model centres; electric cookers and boilers now replace ranges and other apparatus of an older type. The conical iron heaters, with their tendency to discharge unpleasant fumes into the classroom, are removed, and an electric iron complete with its accessories is provided for each girl. The children are instructed in the care and use of the electrical equipment, while the teaching of the careful consumption of electricity provides still another means of emphasising the importance of preventing waste and of exercising wise economy in all forms of home management. The electrical equipment and fittings provided are similar to those which are already installed in a large number of working-class homes, on advantageous terms under a scheme connected with the Council's electricity undertaking. The Committee is satisfied that the installation of this modern equipment will lead to greater efficiency and pride of work, two factors which will do much to raise the status of the housewife, and will in time produce a realisation that the science of conducting and managing a household efficiently requires trained intelligence combined with a certain degree of technical skill. The training given to the girls on these lines will have its influence upon the management of their homes, and if added comfort, better conditions of home life and improved health accrue to the benefit of the members of the household, the Committee feels that one of the principal objects of providing practical instruction for girls will have been achieved.

The accompanying illustrations, figs. 1, 2, and 3, show some of the equipment in one of the Barnsley school domestic centres.

Fig. 2.—A Lesson in Electric Ironing and Cooking.

A Hospital Installation.

The administrative committee of the County Mental Hospital at Prestwich has adopted a scheme involving the electrification of a large portion of its bakery and kitchen, and has placed with the Metropolitan-Vickers Electrical Co., Ltd., a contract for the apparatus required. The installation will be notable as one of the largest of its kind in the country, its service being to cater for patients and staff totalling in all about 1,200 people. The equipment to be supplied includes two electric baking ovens, each capable of baking 400 lb. of bread at a time. They will be of the "Metrovick" conveyor type, each oven having a loading of 50 kW. The ovens will be equipped for automatic temperature control. The installation will also include a kitchen range, three roasting ovens, a fish fryer, and two hot closets and carving tables. These items will be supplied by Messrs. Moorwoods, Ltd., on a sub-contract.

Fig. 3.—Studying the Art of Using Electrical Equipment.

The kitchen range will have two ovens, each with a cooking space of 22 in. by 22 in. by 22 in., with a loading of 5 kW. The top of each range will be fitted with one 3.2-kW and four 1.6-kW boiling plates, while beneath the top will be a grill

toaster rated at 3 kW. Each item is to be 3-heat controlled. The fish fryer will have two pans, each 24 in. sq. by 5 in. deep, with a hot closet below and perforated shelves, drip trays, and a hood above. Each pan will be rated at 7 kW, and the hot closet at 4 kW. Three-heat control, a pilot lamp and fuses will be provided for each circuit.

The roasting ovens are each to have a baking space of 4 ft. by 2 ft. by 2 ft. 4 in. deep, and each chamber will be capable of being divided into two by a suitable heat-insulating shelf, the heating elements in each section being separately controlled. The loading for each oven will be 12 kW.

The hot closets and carving tables will be heated by separate

Fig. 4.—Conveyor-type Baking Oven; 50 kW.

groups of elements at the top and bottom, rated, respectively, at 4 kW and 2 kW. It is interesting to note that the M.V. patented form of magnesium-oxide insulated elements encased in steel tubes has been adopted for heating the oven chambers of the above apparatus, except the baking ovens, which are, of course, heated by the usual type "C" elements. Fig. 4 shows a conveyor oven which is precisely similar to those referred to above.

Chromium-plated Iron.

A recent development in the United States is the production of an electric iron, the base of which is chromium-plated. It is claimed by the manufacturers that the amount of energy required to push an iron with a chromium-plated base across an ironing surface is 30 per cent. less than with the ordinary polished base.

An Electric Washing Machine.

The "Beatty" electric washing machine, fig. 5, a development of Messrs. Beatty Bros., Ltd., 55, Holborn Viaduct, E.C.1, is fitted complete with a reversible wringer, and a positive agitator which is claimed to be the latest and fastest type of mechanism for the thorough cleansing of clothes. The apparatus will deal with an ordinary household wash in an hour with only the aid of hot soapy water. Ball-bearing castors allow of easy movement of the washer, which does

Fig. 5.—The "Beatty" Electric Washing Machine.

not take up much room. The reversible wringer can be swung and locked in seven different positions, and is fitted with rubber-rollers. A quick-release is provided which instantly releases pressure on rolfers. The loading for the machine is claimed to be less than that of an ordinary electric iron.

Mechanical Research.

Small-scale models are capable of demonstrating physical effects of a general character and of providing numerical data which can be applied in full-scale practice with considerable confidence.

By F. C. JOHANSEN, B.Sc. (Eng).

(Extracts from a Paper read before the INSTITUTION OF MECHANICAL ENGINEERS.)

AGAINST the favourable aspects of small-scale apparatus must be set the difficulty, with laboratory equipment, of simulating the working conditions which operate on the large scale. In probably the majority of cases precise representation is impossible; for the most part, however, sufficiently good reproduction to ensure accurate information can be secured by the experienced technician, although the methods of approximating to the required conditions, and of estimating the corrections necessary before the results may confidently be applied to the full scale, call for a high degree of mechanical ingenuity and a thorough knowledge of the physical principles involved.

Tube Trains.—Increased speeds and greater intervals between stations may make the air resistance of tube trains a most important subject for small-scale research. The results of some full-scale trials on the Hudson and Manhattan Railway, U.S.A., show that at speeds of about 30 m.p.h. the air resistance of a train in a tube one mile long is about 60 per cent. greater than that of the same train in the open. The resistance increases rapidly with the length of continuous tunnel, and is probably 20 per cent. less for concrete-lined tunnels than for iron tubes with projecting flanges. At first sight tube-train resistance might appear an obvious subject for wind-tunnel research; the problem is complicated, however, by the large mass of air set in motion by the train; and the determination of the air speed corresponding, in the small-scale experiments, to any stated train speed could hardly be made except by a series of full-scale tests with little promise of accurate results.

In view of the useful service rendered by the trains in ventilating tube railways, the reduction of their air resistance is not an unmixed blessing. With no data as to the magnitude of that resistance, however, it is impossible to decide in what circumstances the installation of ventilating fans would be an economical proposition, nor what length, near the entry of an iron tunnel, it would be economical to smooth over with concrete.

Vibration of Rotors.—Many simple cases yield to mathematical analysis, but small-scale research may prove less laborious than mathematical treatment, and there is scope for research in checking theoretical predictions and in indicating the extent to which such assumptions as underly the theory are admissible.

For the simulation of torsional fluctuations in a model rotor electromagnetic methods appear to offer the greatest facility

in application and control: for example, if each crank be fitted with an iron armature and rotated between the poles of an electromagnet, an impulse, whose frequency is directly controlled by the rotation of the experimental shaft, may be given every one or two revolutions in imitation of the power stroke of the piston. Under these conditions the effects of shaft rigidity, the general inertia of the rotor and the angular position of the cranks at the instant when the external impulse is applied, on the production of torsional vibrations appear to be capable of very close examination. From the main results of such a research it should be possible to lay down the general principles to be followed in designing a machine free from dangerous vibrations.

Turbine Disks.—A type of small-scale research somewhat similar to the last occurs in connection with the vibrations of turbines. There is evidence that failure of turbine disks may be originated by forced vibrations intensified by resonance; mathematical treatment of the problem is so far restricted to very simple cases of disks of uniform thickness, and its results are only remotely applicable to design, since such practical features as curved profiles, shrinking and clamping at the central shaft with their accompanying initial stresses, and the forces due to inertia and reaction at the blades can be only very imperfectly taken into account in the analysis.

In small-scale research on this subject an alternating-current electromagnet fed by a variable-speed motor-generator suggests itself as a suitable means of forcing vibrations of definite and variable frequency in a steel wheel. Exploration of the wave phenomena in a rotating wheel may be carried out by magnetic coils in close proximity to the wheel; one set of coils is stationary in space, whilst the other rotates with the wheel. Variations of the air gap between these coils and the wheel due to vibration of the latter induce periodic fluctuations of current which, after amplification, may be transmitted to an oscillograph and photographically recorded. This type of apparatus has hitherto been employed mainly on full-scale research, but it appears to be equally suitable for small-scale work.

As an example of the use of model turbine wheels of reduced elasticity, for illustrating the vibration phenomena which call for investigation, reference may be made to some preliminary experiments by the General Electric Co. of America. A series of rubber disks, loaded at the circumference to simulate the effect of bucket blades, were rotated and their vibrations examined by intermittent sparks; these and similar observations paved the way to a recognition of the dangerous condition in which waves stationary in space (*i.e.*, travelling backwards at the speed of wheel rotation) occur in turbine wheels. Further experiments on a model wheel fitted with buckets and driven by compressed air demonstrated the production and maintenance of travelling waves due to the feathering action of the buckets. From these experiments it appears that determination of the frequency is an easier matter than the measurement of the deflection of a vibrating body. Both the resonator and the induction-coil oscillograph indicate critical conditions by the relatively large amplitude of recorded vibrations, although the amplitude is not actually measured; the merit of reduced elasticity models lies mainly in the production by such means of measurable, sometimes readily visual, amplitudes.

Torque Vibrations.—An exceedingly interesting application of small-scale apparatus is described in a report* on research on the torque fluctuations in certain types of electric locomotives in which coupled driving wheels are rotated through cranks and connecting-rods. The rotors, represented on the reduced scale by massive disks, were belt-driven by a small electric motor, their motion being transmitted to the coupled driving wheels by variable arrangements of connecting mechanism. By means of a suitable form of torsion-meter fluctuations of turning moment were chronographically recorded. From a specimen chart reproduced in the report it is evident, not only that the frequency and amplitude of the torque fluctuations could be readily measured, but also that critical ranges of speed accompanied by excessive fluctuation, extending between well-defined limits, were clearly exhibited.

* Forschungsarbeiten, 1924, No. 266.

Parliamentary News.

(By Our Special Parliamentary Reporter.)

"Beam" Telegram Charges.

On March 19th, Lord Wolmer informed Mr. Wellock that no general reduction in the charges for "Beam" wireless telegrams was contemplated at present.

Electricity Schemes.

On March 19th, Colonel Woodcock asked the Minister of Transport what arrangements were being made by the Central Electricity Board for the South-West England Scheme; and whether any contracts had yet been placed.

Colonel Ashley said that the scheme for South-West England and South Wales was in course of preparation by the Electricity Commissioners, but had not yet been transmitted to the Central Electricity Board.

Telephone Exchange Fire.

On March 19th, Mr. Scrymgeour asked the Postmaster-General if his attention had been called to the fact that during the recent fire at Llandudno post office a Post Office engineer prevented a fireman from spraying the switchboard with water, "thus averting serious explosions," and if he would state what steps were taken to avoid such a possibility occurring in offices having a large amount of electrical gear.

Sir W. Mitchell-Thomson said that the Post Office engineer prevented the fire brigade from spraying the power plant with water in order to minimise damage, but there was no risk of an explosion. At all telephone exchanges of comparable size, engineers were continuously in attendance.

The Aldershot Co.'s Bill.

On March 20th, the Unopposed Bill Committee of the House of Lords passed the Bill promoted by the Aldershot Gas, Water and District Lighting Co. to extend its area of supply, to enable it to acquire gas and electricity undertakings, and to change its name to "The Southern Power Company."

Lancashire Electric Power Co. Bill.

The Unopposed Bill Committee of the House of Commons passed this Bill for third reading on March 21st. The Bill empowers the company to raise £1,000,000 by the issue of new ordinary shares and to borrow a further amount of £1,000,000.

Metropolitan Railway Bill.

This Bill which empowers the company to raise £500,000 additional capital for improvements has been remitted to the Unopposed Bill Committee of the House of Commons, the opposition to it having been withdrawn.

Co-ordination of London Passenger Traffic.

The Bills providing for the joint control of London's passenger transport services, which are being promoted by the London County Council and the Underground Group, came before a Select Committee of the House of Commons on March 19th. The hearing was a public one, and there were 28 petitions against the Bills, eight of them from Metropolitan borough councils.

Opening the proceedings, Sir Lynden Macassey, K.C., for the Underground Group, and Mr. E. Charteris, K.C., for the L.C.C., said that they intended to call only one witness. Sir Lynden Macassey outlined the provisions of the Bills which, broadly, were to consolidate the services while securing a sufficient measure of public control to protect the interests of the public. Any agreement entered into would be presented to the Minister of Transport to lay before Parliament, and if thought fit by Parliament objections to the agreement could be heard. The promoters were prepared to insert a clause enabling any other transport-owning authority to be admitted as a party to the agreement on suitable terms.

On March 20th, Lord Ashfield gave evidence in support of the Bills. After referring to the success which had attended the operation of the Underground Companies' common fund, he said that his undertakings were unable to proceed with necessary extensions of their systems until they had some measure of protection, such as was afforded by these Bills. It was proposed that the tramway authorities—municipal and company—should form a board which should meet concurrently with the boards of the common fund companies and that the same person should be chairman of each of the boards. It was not proposed to set up a separate common fund for the tramways.

On March 21st, Lord Ashfield was cross-examined by Mr. Stafford Cripps, K.C., on behalf of a number of Metropolitan borough councils, whose main objection was that the Bills lacked two essential features—provision for the publication of an agreement, and the right of objectors to be heard before the agreement was submitted to Parliament. The witness pointed out that arbitration was provided for in a number of circumstances, but he was confident that they could get along without constant resort to arbitration.

A report from the Minister of Transport then came before the Committee. In this the Minister suggested that the question of the reasonable return on ranking capital should be subject to his approval, and that he should be empowered to order a public inquiry if he thought fit.

Mr. Tyldesley Jones, K.C., said that while the promoters agreed that the formula or formulas should receive the approval of the Minister, they did not consider that the matter would be an appropriate one for a public inquiry. Mr. Jones also agreed to a proposal that the local authorities concerned should be enabled to make representations to the Minister with regard to alterations in fares, &c., and that the Minister, after inquiry, should be enabled to prohibit such alterations.

Mr. Charteris, on March 22nd, outlined the recent history of the movement for the proper regulation of transport in London, including the report of the London and Home Counties Traffic Advisory Committee. Subsequently evidence was given by Sir John Gatti, ex-chairman of the L.C.C., and vice-chairman of the Special Traffic Committee of the Council. He pointed to the need for the restriction of uneconomic competition. He said that the London tramway system was the

most rapid of its kind in the world, and there was no other transport system which would give the tramway's advantages without the disadvantages. Although, as an ideal, he would have preferred control by a public body, in the present circumstances he thought that the Underground group was the best body to operate a monopoly. He said that a distinction should be drawn between the operating authority and the regulating authority.

Legal.

Alleged Nuisance from Power Station.

Because of the disagreeable powder and objectionable smell said to emanate from the pulverised fuel plant of the Wallasey Corporation, the Health Committee has decided to issue a summons against the Electricity Committee. The chairman of the Electricity Committee recently stated that exhaustive experiments had been made to overcome the discomforts to people living in the vicinity of the power station. To abate the nuisance to some extent, one of the pulverised fuel plants had been put out of use and the old fuelling system restored.

Sir W. G. Armstrong, Whitworth & Co., Ltd.

In the Chancery Division on March 19th, Mr. Justice Romer approved the reduction of this company's capital by writing off £9,499,688, reducing the loan capital to £3,363,986, and making other arrangements. Although there was opposition to the proposals, his Lordship pointed out that very large majorities of the holders of shares and debentures had approved the scheme.

The "Deion" Circuit Breaker.

Brief details of an American electric switch of unusual design.

Hailed as one of the electrical industry's most important developments of recent years, the invention of a switch based on a new method of interrupting an electrical circuit was publicly announced for the first time at the annual meeting of the American Institute of Electrical Engineers on January 30th in New York City.

Three papers then read revealed the character of the device, which is called the "Deion" circuit-breaker, the name being derived from the essential feature of its operation, which is "the deionisation of an electric arc." Dr. Joseph Slepian, whose invention the device is, read one of the papers, dealing with its theoretical and mathematical aspects. Dr. Slepian is a member of the research staff of the Westinghouse Electric and Manufacturing Company.

In accomplishing the deionisation process, the new circuit-breaker is said to drive an electric arc over a metallic path at the rate of 2,400 miles per hour, much faster than a rifle bullet; the arc itself has a temperature of 5,000 deg. F., yet in spite of such heat, the speed of the arc is so great that a cotton thread held directly in its path is not even scorched, it is declared.

Its name implies its function. The circuit-breaker essentially consists of two metallic contacts which can be drawn apart, and the device is called upon to play the dual roles of Dr. Jekyll and Mr. Hyde, for when the contacts are together the breaker must be a "perfect" conductor; when they are separated it must be a "perfect" insulator. When the circuit is broken while carrying large power, the intervening gap is spanned by an electric arc, and the best method of extinguishing the arc heretofore known to engineers, and that now in general use everywhere, is to immerse the separating contacts in oil; thus, when the metallic contacts are drawn apart, the oil is supposed to stop the formation of, or "quench," the arc. That such an assumption is by no means justified has, however, recently been proved by British research.*

Dr. Slepian's "Deion" method eliminates entirely the use of insulating oil. No attempt is made to "quench" the arc, but, when the arc has formed, it is driven at high speed over a circular track until it dies of exhaustion.

When assigned by the Westinghouse Co. to undertake research on circuit breakers, Dr. Slepian began with an intensive study of the formation and structure of electric arcs; knowing that an arc is essentially a stream of ions, he conceived the idea that if the ions could be removed there would be no arc, but it took him five years to discover a method of using a magnetic field to drive an arc at the rate of 2,400 miles an hour. When travelling at ordinary speeds, if an arc comes in contact with metal it will melt the metal rapidly and use the metal's ions to prolong its own life. At the "Deion" breaker's extraordinary arcing-speed, however, that process is reversed: the arc is driven into a series of copper plates where it is broken up into a series of small arcs, and the copper, "rather than give up its ions, removes ions from the arc instead." If one of the so-formed small arcs should come to a stop for one-twentieth of a second, the copper plates would melt instantly and fuse together. The copper plates into which the arc is driven are circular in shape, and the magnetic field which drives the arcs causes them to follow a circular path around the plates; thus, when an imprisoned arc has made the circuit of the plate 30 or 40 times, "it is so completely drained of ions that its life is snuffed out," we learn.

Circuit-breakers embodying the "Deion" principle have been made in a variety of forms, and the Westinghouse Co. seems to be confident that the principle can be extended to solve a great host of difficult switching problems. The list of applications to date includes small safety switches, electro-magnetic switches for starting and stopping motors, small circuit-breakers for 2,500-volt service and large breakers for 15,000-volt service.

An outstanding feature of the new circuit-breaker is said to be its ability to stand repeated short-circuit tests without the need of maintenance, or attention. One of such breakers was recently made to operate 100 times at current values ranging from 5,000 to 15,000 amperes without any maintenance whatever. The speed of the circling arcs churns the air into such a turbulent state that special openings in the arcing chamber are used to give the switch the necessary ventilation.

Electric railroads and tramway systems should benefit greatly by the new development, it is declared, as the installation of "Deion" breakers will make for greater reliability of generating stations, while their development may also spell the doom of the light fuses which stand as sentinels over the wiring systems of residences; for rather than replacing a blow-out fuse when a current overload occurs, it will only be necessary to push the handle of a small circuit-breaker to reinstate the circuit.

*Elec. Rev., Dec. 28th, 1928, p. 1132.

Correspondence.

Correspondents should forward their communications **as early as possible.** *No letter can be published unless we have the writer's name and address in our possession.*

Climate and Overhead Lines.

I was interested to read the letter from "S.C.B." on March 15th, and am obliged to him for the figures showing the damage done to Post Office lines. Will some of our power company engineers oblige with the corresponding figures for overhead electricity supply lines? I think it is exceedingly unlikely that they will, because my own inquiries to a number of responsible officers in various parts of the country brought me replies which may be summed up in the words "No trouble experienced." "S.C.B." is evidently not a member of the Overhead Lines Association (may we hope shortly to welcome him); when reading my paper, I described in detail the blizzard of March, 1916, and drew attention to the much greater liability of telegraph and telephone lines to damage. With regard to the American loading regulations, the following remarks will be found in the "Discussion" of the National Electric Safety Code, 1928: "The loadings specified for the several localities are not intended to represent the actual pressures and loadings to be encountered in these particular regions, nor can the relative values of the loadings be expected to conform to the assumed values given in these rules. They are, however, quantities chosen after careful consideration of local weather conditions for use in making computations of working stresses. The assumed loadings are not chosen to represent the most severe conditions which are likely to be encountered in the various locations, but are values which have been selected after full consideration of present accepted practice and of the several influences which tend to modify, or diminish, the stresses which might be expected to result from the actual loadings." In other words, it is not an economic proposition to build lines strong enough to withstand extraordinary conditions which occur rarely.

In the 1925 report of the National Electric Light Association, Mr. F. F. Fowle, discussing "Coincident Glaze and Wind Data" from ten U.S. weather bureau stations in or adjacent to Illinois, says, "heavy loading of ½ in. of ice coincident with 8 lb. of wind per sq. ft. is not justified. The actual loading does not exceed one half of 'heavy loading' at most."

The same laying of the ice-ghost is found in the French publication, "Syndicat des Producteurs et Distributeurs d'Energie Electrique; Arrete Ministeriel du 30 Avril, 1927; (translation) "there is no need, in most cases, to consider the possibility of a coating of ice on the conductors, as this occurs much more rarely on power lines than on telegraph or tele-

phone lines, because of the heat produced by the current. However, it is possible, in some districts, *e.g.*, in mountainous country, for deposits of ice glaze to form on the lines; one must allow for this in special cases only."

Major T. Rich pointed out in a paper in December, 1927, that in France there is no record of accident due to conductor breakage.

In Japan severe loading conditions are laid down only for specified districts where snow and ice are experienced. In Japan, also, the gale season comes two months before the snow.

Cav. G. Semenza, who is acknowledged as one of the greatest living overhead-line experts, deals with the question as follows, in his book on the "Graphical Determination of Sags and Stresses for Overhead-Line Construction": ". . . as a rule, the conditions for maximum wind velocity and pressure do not occur at the same time as the conditions for the formation of ice coverings. . . . In Italy it is only in the high portions of the Alps and Appenines that coverings of sleet and ice are formed on electric wires. . . . In the United States it is customary to make allowance for sleet covering in calculating transmission lines, though sleet is rarely experienced. This is probably due, as elsewhere, to the static repulsion of the particles of water from the conductor, caused by the high electric stress, thus preventing the accumulation of water on the conductor surface necessary for sleet formation." He refers also, at some length, to the heating effect preventing ice formations. "A rise in temperature of even only one degree above the atmosphere might make the formation of sleet impossible. Sleet has been known to form at times on high-voltage lines in America, but rarely more than a thin film in thickness. In mountain regions, in still, damp, cold weather, a light frost fabric has been observed to form on conductors at certain critical elevations on the mountains. This, however, is a light open crystalline structure, although it has been observed to form to a thickness of as much as two inches round the conductor. It is, however, thrown off readily by any agitation due to wind."

A study of the Overhead-line Regulations of all countries brings out very clearly the fact that in no other country but our own is it the practice to lay down one set of loading conditions for conductors of all sizes, irrespective of local conditions. "S.C.B." sums up the matter admirably when he says "if light-gauge wires are erected with a proper factor of safety, then the larger gauges of wire will have an unnecessarily high factor of safety." That is exactly the point I intended to lay stress on in my paper, that power lines do not require the same high safety factors as very-light-gauge lines. An amendment of the Regulations for conductors of, say, 0.03 sq. in., or over, would surely have the effect of cheapening construction. I recently had occasion to work out wind pressures for overhead lines in the county of Lincolnshire, and found that the assumption of the loading given in the Commissioners' Regulations had the effect of allowing for a load which, according to the size of the conductor, was from twice to three times the maximum loading which has ever been known to occur in that county during the last 50 years. On top of that, one has to allow for a safety factor of two, giving a true safety factor of four to six. How is it possible to build really cheap overhead lines for rural areas under such conditions?

May I sum up the points I have been trying to make?

(1) When power lines are concerned, we can neglect the ice bogey, except in high mountains, of which we have practically none in this country.

(2) Any tendency for ice to form on lines would be counteracted in the case of h.p. lines by static repulsion, and in the case of l.p. lines by heating.

(3) For real progress in the economical design of power lines, we need to make a sharp distinction between light-gauge communication circuits of, it may be, 40 or 50 wires, strung up somewhere near the elastic limit, and heavier-gauge power circuits, of which one seldom finds more than six lines on one pole, and those erected with what is, taking into consideration the true climatic conditions, an enormous factor of safety.

Every overhead-line engineer knows, of course, that the specified ice loading is an artificial way of describing the permissible stress in a wire; but, if we have got to continue with this, could not the loading be suitably graded according to the size of wire and the locality in which the line is erected?

G. Molle, A.M.I.E.E.

London, *March 18th*, 1929.

London Trunk Power Cables.

Reverting to my recent correspondence and also to Messrs. H. J. Baldwin & Co.'s letter of the 8th inst., I would like to make it clear that I am in agreement with Messrs. Baldwin that interlocking tiles are, in my opinion, quite as satisfactory as concrete slabs, and I am sorry if my previous letter did not support that view.

Resident Engineer.

March 22nd, 1929.

Reviews.

Pioneers of Wireless. By Ellison Hawks, F.R.A.S. Pp. xix+304; 24 plates and 45 diagrams. London: Methuen and Co., Ltd. Price 12s. 6d. net.

Mr. Hawks goes far back in history for his first pioneers; in fact, Clerk Maxwell is not reached until halfway through the book. This means that the purely wireless, or, more accurately, radio, portion of the book is shortened, but it has the advantage of presenting a more detailed description of the earlier work on conduction and induction methods, work which is not now so widely known.

A summary of the work of the great electrical pioneers from Gilbert to Joseph Henry occupies the first 60 pages, and the next 100, including an interesting chapter on the discovery of the telephone by Bell, take us through the work of the pioneers of signalling without wires by conduction and induction. We notice that the author puts a "please" into the famous first telephone message, though Dr. Watson himself is wont to quote it as: "Mr. Watson, come here, I want you," the form usually given.

The next 50 pages lead us from Hughes through Clerk Maxwell (misspelt throughout with a hyphen), Hertz, Lodge, Branly, Tesla, Popoff to Marconi. We are glad to see how adequately the author deals with the work of Hughes, but we are surprised that no mention is made of the pioneer work of Commander Jackson, R.N. His work was not recognised for some time as its details were contained in confidential reports to the Admiralty, but it is long now since it was publicly known, and three years ago the Royal Society awarded the Hughes Medal to Admiral Jackson "for his pioneer work in radiotelegraphy and its application to navigation."

The last 80 pages give an excellent account of Marconi's early work, and a short summary of the work of other pioneers which led up to the establishment, two years ago, of a wireless telephone channel across the Atlantic. This summary could, of course, be expanded almost indefinitely, but it is clear that the author feels that the real pioneer work closed with Marconi's first tests across the Atlantic. On the whole, we should have preferred an expansion of this later work even if it had entailed a curtailment of the pre-radio period.

In this final section we note that Major Armstrong is mentioned as the discoverer of the regenerative principle, the book was published before the Supreme Court of the United States had upheld the claims of Dr. de Forest in this connection.

The author has done a service to the general reader by putting in the forefront the human side of the history of wireless, and indeed he gathers up the whole subject into a most interesting story. But the book will not only be welcomed by the general reader. Mr. Hawks has taken pains to be accurate in his statements, and his book should prove useful, as well as interesting, to that ever-expanding body of wireless workers, professionals and amateurs alike.

Electrical Transmission and Distribution. Vols. III and IV. By R. O. Kapp. Pp. vi+viii+479–1003. London: Sir Isaac Pitman & Sons, Ltd. Price 6s. each volume.

The subject of switch and control gear is dealt with in the third and fourth volumes of this series. Vol. III is generally descriptive in character, and forms a useful and well illustrated review of modern practice in the field of switchgear for all voltages. Switchgear for use on super-generating voltages is dealt with by Mr. W. Anselm Coates. The first section dealing with this branch is concerned with the layout of large equipments, and representative examples of outdoor structures are described and illustrated, whilst modern armourclad gear is fully dealt with. The second section deals with the components of equipments for super-generating voltages. The author considers the physical and electrical properties of insulating materials, and the details of the construction of insulating fittings for super-tension work. Modern oil circuit breakers for this class of duty are described and illustrated, as are the various types of lightning arrestors in common use. It is somewhat surprising to find the now obsolete expression "potential transformer" on p. 613.

Dr. C. C. Garrard contributes the section dealing with switchgear for a.c. generating voltages. Representative examples of modern gear of this class are described, and there is a useful paragraph on bus-bar reactances or on the elementary theory underlying their use.

The section dealing with switchgear for d.c. and low-pressure a.c. circuits has been written by Mr. J. M. Goodall. Here we find well illustrated descriptive matter relating to switches and circuit breakers for this class of duty, although the omission of any account of the high-speed circuit breaker from this section is somewhat surprising. It is intimated, however, that this class of breaker will be described in a future section dealing with automatic switchgear. Typical lay-outs of low-pressure switchboards are illustrated in this section, and a number of detailed schedules of equipments for various circuits, both a.c. and d.c., are included.

Vol. IV is generally of a more practical character than the one preceding, in that it contains two valuable sections dealing with the care and operation of switchgear and with protective gear for a.c. systems. The first of these sections, from the pen of Mr. V. A. Brown, contains a large amount of good

and useful matter relating to the maintenance of switchgear, although there is some descriptive matter which overlaps that in the previous volume. Directions are given for the routine testing of protective gear. This is somewhat more perfunctory in character than so important a subject demands. We find, for instance, that in describing the test for the balance of the transformers in a Merz-Price circulating-current system for an alternator, it is stated that no reading will be obtained with a low-resistance milliammeter in the relay circuit. As a matter of fact, of course, a small reading is usually obtained, and the matter of importance is the maximum safe value of the extraneous current for given circumstances.

The middle section of this volume, from the pen of Mr. Goodall, deals with ironclad switchgear of the industrial type, for voltages up to 3,000. The treatment is generally descriptive, and, beyond recording that the subject seems adequately covered, this section calls for no particular comment.

The last section, by Mr. B. H. Leeson, covers the subject of protective gear, and occupies one half of the volume. This section is very penetrating, and will well repay careful study by all who are concerned with, but not thoroughly versed in, the developments of modern protective gear. The author arranges various types of protective gear in logical sequence, and we are pleased to see that the system of distance protection, involving the use of impedance relays, receives adequate attention, especially in view of the adoption of this system for the new transmission schemes now in process of development in this country. There appears to be a tendency in this section to lay stress on certain systems of protection, whilst others for similar duty are dismissed with a passing mention. We notice, for instance, that no description is given of the important B.T.H. system of parallel feeder protection which embodies the unique feature of differential leakage protection with a light setting. The author makes considerable use of what he calls stability diagrams, which seem to be based on the assumption that the extraneous relay currents in differential systems increase proportionally to the straight-through current. It is very questionable if this simple relationship actually holds.

These two volumes will be very acceptable to engineers concerned with the maintenance and operation of such stations, and also to the general engineering reader. As works of reference they would have been more useful had fuller indexes been provided.

Practical Primary Cells. By A. Mortimer Codd, F.Ph.S. Pp. viii+127; figs. 53. London: Sir Isaac Pitman & Sons, Ltd. 1929. Price 5s. net.

The number of books dealing with primary cells has become very numerous in recent years, and as the general features of cells in design and construction have to a considerable degree become standardised, there must necessarily be some degree of sameness in the treatment of the subject and in the information given by the various authors. The volume under review, however, will certainly rank highly amongst the literature on the practical aspects of primary cells. The author of this work has produced a book which should be of service to all having to do with the working details of primary cells, both from the laboratory and commercial standpoints. The initial chapters of the book deal with the simple voltaic cell; the later chapters deal with dry cells, two fluid cells and the maintenance of batteries.

The care of batteries, particularly where there is a large number of cells, is essential to economical working. Generally speaking, batteries should be installed under such conditions that they can be kept at a cool, fairly constant temperature, and are easily cleaned and ventilated. Extreme variations in temperature lead to excessive differences in the internal resistance of the cells, a complaint to which some types of cells are extremely susceptible. Cleanliness and ventilation are also necessary in order to avoid leakage through creeping and discontinuities due to corroded terminals. The author has included in the form of an appendix, a highly serviceable list of a large number of voltaic cells which have been invented since Galvani's discovery in 1786; the basis of the selection is either historical interest, first invention, or practical utility.

A certain amount of information has been forthcoming of late years on cell manufacturing processes. One would have appreciated, where possible in a volume of this type, a little fuller treatment of the actual production of cells, together with diagrams of plant used. The volume is, in general, a useful contribution to the literature on the subject, though little attempt is made to weigh up the advantages and disadvantages of the various types of cells. With this reservation, the book will be found to be a serviceable and reliable guide. The volume has been written in a clear and incisive manner, the type and illustrations are good, the line drawings being particularly clear. The style in which the book is issued contributes a share to the attractiveness of the volume.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

An Automobile-lighting Time Switch.

To provide means of switching on the lights of motor vehicles when standing unattended in public roads or places where it is necessary to "light up" at the proper time, Setalite, Ltd., 1-4, Morley House, Regent Street, W.1, have introduced the "Setalite," fig. 1. This takes the form of a novel clock time switch which is automatically wound up

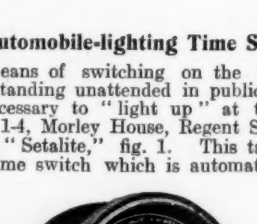


Fig. 1.—The "Setalite."

in the setting operation. The setting, which is effected by a centre knurled knob, is arranged according to the length of the period, hours and minutes, from the time of setting until lighting-up time. The apparatus has a maximum working range of six hours. Provision is made for either housing the instrument in the cubby hole or fixing it to the dashboard.

A New Switch Fuse.

The 4-pole "Safetee" switch-fuse is a recent introduction of Messrs. L. Weekes (Luton), Ltd., Luton, Beds., and has been specially developed for use on 2- and 3-phase, 4-wire systems. Briefly, it consists of two d.p. fuse and switch contact carriers, which move along large machined guides and are operated by toggle mechanisms, all mounted on the lid, the fixed contacts and cable connections being mounted near the bottom of the switch case. All the current-carrying parts are secured on mica-insulated steel supports, and will carry, it is claimed, 50 per cent. overload indefinitely. The lid cannot be opened or closed with the switch in the "on" position. When open, the whole of the interior is very accessible. There are two breaks per pole, and quick breaking is made by powerful pull-off springs, the impact being taken up

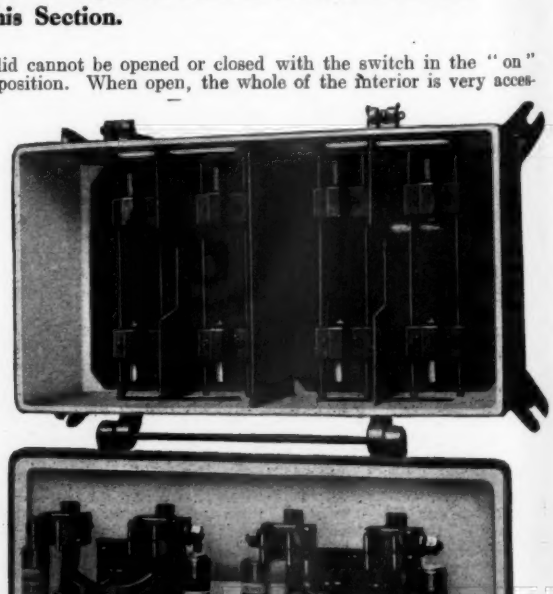


Fig. 2.—"Safetee" Four-pole Switch Fuse.

by suitable buffer springs. After the contacts open, the quick-break functions independently of the handle. Suitable springs and carefully machined parts make the switch pleasing to operate. Micanite carriers are provided between phases, and if required the switch-fuse can be supplied mica lined throughout. By a slight modification the apparatus may be used as a d.p. change-over switch, the operating handle being made to engage with either mechanism, the change being made in the "off" position. Fig. 2 shows the standard equipment, which is made in sizes for loadings from 100 A to 500 A at 500 V. Similar mining-type and water-tight switch-fuses are made to order.

Adhesive Insulating Cord.

We have received from the Friho Manufacturing Co., Ltd., 283, City Road, E.C.1, some samples of "Ikfama" adhesive insulating cord, which, it is claimed, is equal in quality to the best insulating tape, and is clean to handle. It is made in three widths and lengths: 2-strand or 1-mm., about 132 yards long; 4-strand or 2-mm., about 66 yards long; and 6-strand or 3-mm., about 44 yards long. It can be supplied in black, white, grey, red, pink, yellow, green, blue and brown. The cord is wound on metal reels, and each reel is placed in a metal box which serves as a holder during use.

Published Specifications.

Compiled expressly for this journal by a firm of chartered patent agents. The numbers in parentheses are those under which the specification will be numbered and abridged, and all subsequent proceedings will be taken.

1927.

22,652 "Light-sensitive apparatus for producing or amplifying alternating currents." J. Neale. August 29th, 1927. (307,086.)

23,116. "Submarine telephone cables." W. S. Smith, H. J. Garnett, and H. C. Channon. September 2nd, 1927. (307,087.)

25,176. "Gramophones, loud-speakers, and the like acoustic instruments." A. A. Linsell. September 23rd, 1927. (306,915.)

25,290. "Means for connecting electrical pick-up devices for gramophones and the like with radio receivers." A. Andrews and Dubilier Condenser Co. (1925), Ltd. September 26th, 1927. (306,855.)

28,608. "Means for supporting electrical sound-recording or sound-reproducing or other like electrical vibratory devices." W. E. Clifton. October 27th, 1927. (307,091.)

29,129. "Electrical regulators." British Thomson-Houston Co., Ltd. November 24th, 1926. (281,243.)

29,545. "Electrolytic cells." R. Edgeworth-Johnstone. November 4th, 1927. (307,093.)

31,382. "Cone diaphragms for sound amplification or reproduction." F. Brinkmann. June 24th, 1927. (292,569.)

31,383. "Hornless loud-speakers." F. Brinkmann. June 24th, 1927. (292,570.)

31,385. "Hornless loud-speakers." F. Brinkmann. June 24th, 1927. (292,571.)

31,387. "Magnet systems of telephone instruments." F. Brinkmann. June 29th, 1927. (292,989.)

31,495. "Enclosed electrical apparatus." British Thomson-Houston Co., Ltd., and H. C. Heath. November 23rd, 1927. (306,862.)

31,831. "Frequency-responsive apparatus." F. G. Dyrna. November 25th, 1927. (306,865.)

31,883. "Electric controllers." Electrical Apparatus Co., Ltd., and R. H. Barbour. November 26th, 1927. (306,868.)

32,065. "Electric switches." J. A. Crabtree. November 29th, 1927. (306,919.)

32,079. "Means for the winding of electric flex extensions." F. F. D. Davidson. November 29th, 1927. (306,920.)

32,127. "Thermionic valves." Radio-technique. December 31st, 1926. (292,727.)

32,158. "Automatic and semi-automatic telephone systems." Siemens Bros. and Co., Ltd., C. Lambert, and W. G. Patterson. November 29th, 1927. (306,922.)

32,161. "Induction motors." Dr. B. Schwarz. November 29th, 1926. (281,344.)

32,253. "Headlamps for motor-cycles and the like." British Thomson-Houston Co., Ltd., and H. N. Sporborg. November 30th, 1927. (306,987.)

32,284. "Testing devices for impulse senders." Automatic Telephone Manufacturing Co., Ltd., and T. P. Preist. November 30th, 1927. (306,990.)

32,285. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., and W. Saville. November 30th, 1927. (306,991.)

32,288. "Colloidal diaphragms for electrolytic cells." G. F. Jaubert. December 1st, 1926. (281,674.)

32,395. "Load-sharing arrangements for dynamo-electric machines." A. Reyrolle & Co., Ltd., and G. E. Grace. December 1st, 1927. (306,995.)

32,409. "Manufacture of photo-electric cells." General Electric Co., Ltd., and N. R. Campbell. December 1st, 1927. (306,996.)

32,420. "Manufacture of electron-emitting bodies." E. Y. Robinson and Metropolitan-Vickers Electrical Co., Ltd. December 1st, 1927. (307,099.)

32,425. "Cycles and similar light vehicles adapted for laying telegraph wires and the like." R. H. Smith. December 1st, 1927. (306,999.)

32,431. "High-tension electric cables." Siemens-Schuckertwerke Akt. Ges. December 2nd, 1926. (281,692.)

32,453. "Galvanic cells." Dr. A. Schmid. December 2nd, 1926. (281,698.)

32,581. "Electromagnetic acoustic devices, such as loud-speakers." British Thomson-Houston Co., Ltd., and A. P. Young. December 2nd, 1927. (307,106.)

33,370. "Regulation of asynchronous alternating current machines." English Electric Co., Ltd., and G. Schroeder. December 9th, 1927. (307,121.)

33,480. "Method of, and means for preventing faulty action due to the effect of the magnetic field of the current circuit in cable protective devices." Siemens-Schuckertwerke Akt. Ges. December 14th, 1926. (282,386.)

33,649. "Electric fires or radiators." F. J. Wineberg. December 13th, 1927. (307,127.)

34,013. "Cord grips for electric fittings and appliances." W. V. Butterfield, A. W. Butterfield, and S. Butterfield (trading as Mycromet Manufacturing Co.). (Patent of addition not granted.) December 15th, 1927. (307,131.)

34,711. "Electromagnets and electromagnetically-operated devices." Siemens Bros. & Co., Ltd., T. S. Robertson, and W. E. Goodwin. December 22nd, 1927. (Cognate application, 7,696/28.) (307,138.)

34,954. "X ray tube shields." A. F. Pieper. December 23rd, 1927. (307,143.)

1928.

1,449. "Protective device for plugs for electric plug contacts." P. Ratzsch and E. Stracke. January 16th, 1928. (307,158.)

2,735. "Evacuation of closed vessels." Westinghouse Lamp Co. February 1st, 1927. (284,623.)

3,020. "Methods of insulating the exposed parts of the metal bridges of the tumbler type of electric switch." C. L. Arnold and M.K. Electric, Ltd. January 31st, 1928. (307,173.)

3,811. "Wireless receiving systems." A. R. Jones. February 7th, 1928. (307,177.)

4,017. "Apparatus for controlling the exposure of a unit to a source of electric light.' Pictorial Machinery Ltd., and B. Cook. February 8th, 1928. (307,181.)

4,416. "Combined clock and wireless loud-speaker." H. T. Stott. February 11th, 1928. (307,192.)

4,885. "Head lamps for motor road vehicles." S. Masson. February 16th, 1928. (307,197.)

5,028. "Manufacture of insulating tapes or the like." International General Electric Co., Inc. February 18th, 1927. (285,497.)

6,610. "Electro-dynamometers." Siemens & Halske Akt. Ges. March 3rd, 1927. (286,308.)

6,698. "Cleats for supporting electric conductors." Callender's Cable and Construction Co., Ltd., and F. H. Simkin. March 3rd, 1928. (307,210.)

6,717. "Junction boxes for electrical cables.' A. Chalmers. March 3rd, 1928. (307,211.)

7,418. "Method of producing moulded articles, such as sheets and the like, suitable as insulating material for electro-technical purposes, from filling materials and artificial resin." Schieferwerke Ausdauer Akt. Ges. March 10th, 1927. (286,732.)

7,649. "Electric speed-indicating apparatus." G. Mombur. March 12th, 1927. (287,074.)

7,707. "Automatic stopping devices for electric lifts." Smith, Major and Stevens, Ltd., and P. H. Stevens. March 13th 1928. (307,217.)

8,162. "Boiling plates for electric cookers." A. J. Howard and L. V. Turner. April 28th, 1928. (307,221.)

9,580. "Electric speed-indicating apparatus." G. Mombur. April 8th, 1927. (Addition to 287,074.) (288,285.)

9,613 "Star-delta method of starting alternating-current motors." Naamlooze-Vennootschap Hengelosche Electrische en Mechanische Apparatenfabriek and A. Booden. March 31st, 1928. (307,231.)

10,733. "Radio receiving systems." L. Mellersh-Jackson (Federal Telegraph Co.). April 11th, 1928. (307,237.)

11,375. "Picture telegraph and the like apparatus." Etablissements E. Belin. April 27th, 1927. (289,431.)

11,586. "Apparatus for measuring a low gaseous pressure such as that of a vapour-electric discharge device." British Thomson-Houston Co., Ltd. April 21st, 1927. (289,059.)

14,387. "Electric heating devices." P. A. Klinge and O. E. Borgstrom. May 16th, 1928. (307,249.)

15,299. "Thermal regulator for electrically-heated devices." P. A. Klinge and O. E. Borgstrom. May 24th, 1928. (307,252.)

15,973. "Dirigible headlights for automobiles." A. E. Daly. June 23rd, 1927. (292,585.)

16,418. "Multiple thermionic valve for a frequency-changing receiver." W. Kunze and Radiofrequenz Ges. December 18th, 1926. (Divided application on 282,444.) (291,735.)

35,776. "Coupling devices for use in wireless telegraphy and telephony." Nederlandsche Telegraaf Maatschappij Radio-Holland. December 6th, 1927. (301,831.)

Trade Mark Applications.

The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from March 20th:—

Clarostat. No. 492 651. Class 8. Variable electrical resistances.—Claude Lyons, Ltd., Old Hall Chambers, 76, Old Hall Street, Liverpool.

Sarezite. No. 498,496. All goods in Class 8.—P. Kay, Ltd., 183, Old Street, London, E.C.2.

Dualite (lettering and design). No. 491,953. Class 13. Lamps (ordinary) and lighting fittings. No. 491,954. Class 18. Lighting installations, heating apparatus for buildings, and cooking stoves.—Dualite, Ltd., 18, Bartlett's Buildings, E.C.4.

Magnifleet. No. 498,588. Class 13. Lamps (ordinary) and reflectors.—Astra Dynamo Co., Ltd., 124, Victoria Street, S.W.1.

Sunbeam. No. 484,296. Class 18. Electric lighting, power and ignition sets, all being parts of motor cars.—Sunbeam Motor Car Co., Ltd., Moorfield Works, Wolverhampton.

Weather Charts by Wireless.

That daily weather charts are to be transmitted by wireless was announced by Mr. R. A. Watson Watt, superintendent of the radio research station at Slough, in the course of the G. J. Symons Memorial Lecture delivered by him before the Royal Meteorological Society. The subject of his lecture was "Weather and Wireless," and according to the *Financial News*, Mr. Watt said that experimental transmissions would be made from Daventry on the Fultograph system. Wireless as a means of communication, he said, was essential in modern meteorology because it alone was capable of giving sufficiently rapid interchanges of data over wide areas. Atmospherics might be counted arriving at the rate of 3,000 or 4,000 per second in a tropical night. The average atmospheric was 100,000 times as strong as a readable signal. Atmospherics had been known to disturb broadcast reception up to 4,000 miles from their place of origin. The predominant source of the world's supply of atmospherics at any moment was usually in a land where it was summer afternoon. The average atmospheric received in England was of such strength as would be sent out by a thunderstorm 2,000 miles away. Visual direction-finders had accurately located thunderstorms in progress at places 1,000 or 2,000 miles away. Extensions of the applications of wireless telegraphy in meteorological communications might well include the transmission of three-colour charts, in which the fronts were indicated in distinctive colours. The detection and location of thunderstorms by wireless direction finding on atmospherics had been tested, and further experimental work was likely to lead to applications of this method in the meteorology of air routes.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ABINGDON.—Extensions, Radcliffe Infirmary, with electrical department (£120,000), for the directors; secretary.

AYR.—Corporation housing scheme (£21,760); burgh surveyor.

BARNES (Surrey).—Extensions, Kew Works, Mortlake Road, for Kent Bros., and E. H. Phillips, Ltd.

BEXLEY (Kent)..—Houses (67), Woodlands estate, for S. H. Alabaster. Mission hall, Station Approach, Welling, for William Grubb.

BIGGLESWADE.—Re-erection (after fire) of works, The Baulk, for P. C. Kidman.

BROADWAY.—Housing scheme (52), for Evesham R.D.C.; R. J. Atkinson, surveyor, 64, Port Street, Evesham (returnable deposit of £2 2s.).

BURNLEY.—Enlargement of Victoria Hospital; secretary.

BURY.—Housing scheme (about 200), Huntley Brook, East Ward and Lower Chesham; borough engineer.

BURY ST. EDMUNDS.—Senior girls' school (£25,000), Grove Park estate, for the Voluntary Schools Fund Committee; A. R. Ryan-Tenison, architect, 21, Great Peter Street, London, S.W.

CHESTERFIELD.—St. Augustine's Church (£11,000); Rev. C. Mudford.

COLEFORD (Glos.).—Re-erection (after fire), of Clearwell Castle, seat of Lieut.-Col. C. G. Vereker (£40,000).

COMPTON MARTIN (Bristol).—Re-erection (after fire) of Hazel Manor (mansion), residence of Charles Tucker.

DAVENTRY.—Electric lighting installation, Institution, for the Board of Guardians; clerk.

DROITWICH.—Spa, with concert hall, kinema, hotel, &c. (£250,000), for the Droitwich Development Co., Ltd.; secretary.

DUKINFIELD.—Housing scheme (32), Lord Street site (deposit £2 2s.). Housing scheme (54), Lodge Lane site (deposit £2 2s.).; borough surveyor.

ECCLES.—Housing scheme (82), Anson Street and Lane End; T. Elce, borough engineer.

FALKIRK.—136 houses, for Corporation (£18,200); burgh surveyor.

GLASGOW.—X-ray department at Western Infirmary (£18,000); the medical superintendent. Cabinet factory (£90,000), for Scottish Co-operative Wholesale Society, Shieldhall; the manager. Wash-houses at three sites (£100,000); city engineer.

GRANTHAM.—Additional 50 houses, for the T.C.; borough surveyor.

HALIFAX.—Development of Bull Green site, with offices, shops and library, for the T.C. (£24,000); A. C. Tipple, borough engineer.

HALSTEAD (Essex).—Housing scheme (36), for the U.D.C.; W. A. Nicholson, surveyor.

HARPENDEN.—Housing scheme (50), Westfield estate, for the U.D.C.; surveyor.

HASTINGS.—Re-building station (£202,000), for the Southern Railway Co.; engineer.

HELENSBURGH.—Church hall (£5,500), for Park U.F. Church; H. Mitchell, architect.

HORNCHURCH (Essex).—Bank, High Street; Westminster Bank, Ltd. Houses (59), Slewins estate, for Standen Bros. Houses (44), Osborne Road, for C. A. Piper.

IRISH FREE STATE (Cork).—Bishop's Palace, Farranferris; J. R. Boyd, architect, 61, South Mall.

(Dublin).—Electrically-driven pumping plant at Stillorgan; city engineer, 28, Castle Street.

(Enniskillen).—Boarding school, for Convent of Mercy (£14,200); J. Donnelly, architect.

KILMARNOCK.—Extensions, Longpark Pottery, for J. and M. Craig.

LEEDS.—Secondary school, Far Headingley (deposit £2 2s.); Architect's Section, Education Department, Calverley Street.

LEWES.—Bazaar premises, Cliffe High Street, for F. W. Woolworth & Co., Ltd., Kingsway, London.

LEXDEN AND WINSTREE.—Additional 50 houses, for the R.D.C.; surveyor.

LICHFIELD.—Cinema,, Friary Road, for the Inter-European Film Syndicate, Ltd., 37, Walbrook, E.C.4.

LONDON (Hackney, E.).—Housing scheme, 42 acres, Eastern Arterial Avenue; borough engineer. Five blocks of flats, Southwold Road; Gee, Walker & Slater, Ltd.

(Ilford, E.).—School, Goodmayes (500 places), for the borough E.C.; Adam Partington, clerk.

(Islington, N.). — Extensions, Northern Polytechnic (£65,000); governors.

(Willesden, N.W.).—Secondary school, Dollis Hill; Middlesex Education Committee.

(Deptford, S.E.).—Blocks of dwellings, Oliver Goldsmith estate (£92,000); L.C.C. architect.

(Fulham, S.W.).—375 tenements and 14 shops, Fulham Road (£271,000); borough engineer.

(Kensington, S.W.).—Shops, West Kensington station, for L.M.S. Railway Co.; A. P. J. Ball.

(Putney, S.W.).—Extensions, Huntingfield School (£16,000); L.C.C. architect.

(Wandsworth, S.W.).—Rehousing scheme, Wandsworth Plain area (£180,000); borough engineer.

(Wimbledon, S.W.).—Restaurant (£10,000); A. E. Chapman, Wimbledon Hill Hotel, North Wimbledon.

(Ealing, W.).—Factory at Northfield Avenue, for Ideal Cleaners and Dyers, Ltd.; W. S. Grice, architect, 7, Gray's Inn Place, W.C.1.

(W.C.).—Extensions, Civil Service Supply Association, Strand; Simmons & Simmons.

LYMINGTON.—Housing scheme (50), for the T.C.; borough surveyor.

MANCHESTER.—Proposed housing scheme (200), Moston; H. Price, city architect, Town Hall. Police offices, near South Street; H. Price, city architect, Town Hall.

MITCHAM.—Secondary school; Surrey Education Committee.

NEWTON.—Technical school (£31,200), for Lancs. E.C.; Thomas Taylor & Co., builders, Littleborough.

NORTHALLERTON.—Roman Catholic church, Thirsk Road; Priest-in-charge.

OXFORD.—Chapel and lecture room, Bishop King's Palace, Rose Place; Prof. Francis de Zulueta.

PAISLEY.—Church for St. Mirin's R.C. congregation (£25,000); priest-in-charge. School (electric lighting); clerk, School Management Committee. Nurses' home; Committee of Management, Paisley Infirmary.

PEEBLES.—Housing scheme (48); burgh surveyor.

PERTH.—Hospital block at James Murray's Royal Asylum (£18,000); Smart, Stewart & Mitchell, architects, 42, Tay Street.

PORTSMOUTH.—57 houses, off Teignmouth Road; R. J. Winnicott. 150 houses, off London Road, Cosham; Dockyard Employés' Housing Association, Ltd. 32 houses, Green Lane, Copnor; S. Brittan. Tram depôt, Eastney; tramway manager. Berth extensions, Camber Dock (£4,200); city engineer.

SHORNCLIFFE.—Regimental institute (£10,000); R. J. Barwick, builder, Dover.

SLOUGH.—Theatre (£50,000); H. D. Bowyer, builder.

STRANRAER.—Housing scheme (30); borough surveyor.

SUNBURY.—School (500 places), for Middlesex E.C.; H. M. Walton, secretary, 40, Eccleston Square, London, S.W.

SURREY.—Clinics at Dorking, Epsom, and Lingfield; County architect.

SWANSEA.—Aerodrome; borough engineer. Civic centre buildings, Victoria Park (£300,000); Special Corporation Committee. 103 houses, Townhill estate; C. Sansom, Bridgend.

THORNABY-ON-TEES.—Houses (50), for the T.C.; H. E. Pitt, builder, Sunderland.

TILEHURST (Reading).—Church, Norcot estate; A. H. R. Tenison, architect, 21, Great Peter Street, Westminster.

TORQUAY.—Cinema, for the Burlington Picture House (Torquay), Ltd. Extensions, Hotel Regina, Victoria Parade, for A. J. Plumb. Rebuilding bazaar premises, Union Street, for Marks & Spencer, Ltd., London. Houses (45), Teignmouth Road, for R. Riggs. Isolation hospital (£11,600), for the T.C.; borough surveyor. Extensions to Babbacombe Cliff Hotel, Babbacombe; J. H. Scoles, architect.

WATERLOO-WITH-SEAFORTH.—Housing scheme (33), Holden Street (deposit £1 1s.); surveyor to U.D.C., Town Hall.

WEST HARTLEPOOL.—Extensions, Cameron Hospital; secretary.

YEOVIL.—Shops, flats, garages, Peter Street and Union Street, for C. L. Norman.